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Review

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Carbohydrate-Insulin Model in Obesity- An Updated Review

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Abstract

The prevalence of obesity is increasing rapidly worldwide and represents a serious public health problem. In order to prevent obesity, the causes of obesity should be identified and appropriate interventions developed. In this review, the carbohydrate-insulin model, which is one of the causal perspectives to obesity, and recent studies on this approach are discussed and evaluated together with the energy balance model. Reduced total energy expenditure when adhering to healthy dietary recommendations without energy restriction or dietary energy restriction interventions makes it difficult to understand the energy-independent insulinaemic effect of diet. Although more studies are needed on the causal approaches to obesity, it was concluded that high-fibre and low-glycaemic load diets, rather than carbohydrate-restricted diets in the carbohydrate-insulin model, may give more favorable results in trials. In addition, individualized nutritional and dietary models should be developed under the guidance of a dietician in the treatment of obesity.

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1. Introduction

Obesity and obesity-related deaths are increasing rapidly around the world. According to the World Health Organization, at least 2.8 million people die each year because they are overweight or obese (WHO, 2023). To prevent obesity, the causes of obesity should be identified and individual and societal interventions should be developed to address these causes. In addition to the Energy Balance Model (EBM) in identifying the causes of obesity, the Carbohydrate Insulin Model (CIM), which is a more recent approach, is also discussed. This review analyses the CIM, which has been proposed as one of the causes of obesity, and compares it with the EBM. The EBM approach to obesity is more concerned with positive energy balance, while CIM focuses on hormonal and metabolic responses rather than calorie intake (Ludwig et al., 2021, Ludwig et al., 2022). The CIM model proposes metabolic processes that cause insulin resistance. In the CIM, high circulating fatty acids and other metabolites activate protein kinases such as Protein Kinase C (PKC), Jun kinase (JNK), and inhibitor of nuclear factor-κB (NF-κB) kinase-β (IKKβ), and may cause these kinases to impair insulin signaling by increasing inhibitory serine phosphorylation of insulin receptor substrates (IRS) (key mediators of insulin receptor signaling) (Petersen & Shulman, 2006). It is also reported that TNF-induced insulin resistance is associated with increased IL-18 gene expression in muscle tissue (Krogh-Madsen et al., 2006). It is suggested that this is due to the transcription of miR-146b, an intergenic miRNA that can regulate the inflammatory process by attenuating cytokine signaling via nuclear factor-κB (Shi et al., 2014).

2. Methodology

PubMed, Sciencedirect and Wiley databases were used to search for relevant literature. Keywords included carbohydrate-insulin model, energy balance model, obesity, complex carbohydrates, carbohydrate quality, glycemic index, glycemic load, insulin resistance, blood glucose, type 2 diabetes and various combinations of these terms. Research articles, narrative reviews, systematic reviews and meta-analyses published in the last 10 years were analysed. Only articles published in English were included.

3. Carbohydrate Insulin Model

There are two different views to explain the causes of obesity: EBM and the CIM. In the EBM, an increased intake of energy-dense, palatable, ultra-processed foods with a change in dietary pattern provides a positive energy balance and causes an increase in the amount of body fat (Ludwig et al., 2021). The CIM hypothesis is that increased fat content triggers the desire to overeat (Ludwig et al., 2022). In the energy balance approach, dietary interventions take the form of energy restriction, since a positive energy balance increases the body weight of individuals. However, CIM argues that carbohydrates that stimulate insulin release should be reduced to reduce body fat (Hall et al., 2015). Insulin plays a key role in this model. Insulin reduces ketone production in the liver, stimulates glycogen and fat accumulation by allowing circulating glucose to be taken into the cell (Ludwig

& Ebbeling, 2018). Refined carbohydrates in particular are insulinaemic and have a very high glycaemic load (GL).

When these high-GL foods enter the body, they are digested very quickly and induce the release of insulin and glucagon-like peptide-1 (GLIP-1), inhibit lipolysis and promote fat accumulation in adipose tissue (Ludwig & Friedman, 2014). Therefore, this dietary pattern causes hyperinsulinemia, which leads to an increase in adipose tissue and sheds light on the relationship between obesity and hormonal response (Taubes, 2007).

4. Carbohydrate Quantity/Quality in the Carbohydrate-Insulin Model and Comparison with the Energy Balance Model

In the CIM approach, it has been reported in the literature that foods with a high glycaemic load trigger obesity. In this approach, research generally focuses on dietary carbohydrate ratio and carbohydrate quality. This is a controversial topic because the research is very conflicting.

4.1. Carbohydrate Quantity

Dietary carbohydrate intake is reduced in three categories (reduced carbohydrate diet, low carbohydrate diet and very low carbohydrate diet). In a reduced carbohydrate diet, at least 130 g of carbohydrates are consumed daily and the amount of carbohydrates does not exceed 45% of total energy intake. The carbohydrate restriction in a low-carbohydrate diet is between 30-130 g per day. Very low carbohydrate diets contain <30 g of carbohydrate per day. Studies have generally compared low-carbohydrate diets with low-fat diets (10-15% of total daily energy intake from fat) (Hite et al., 2011).

In a study by Hall et al. (Hall et al., 2015) of 19 obese American subjects, which examined the effects of fat-restricted and carbohydrate-restricted diets of equivalent energy on fat oxidation and body fat loss, it was found that fat oxidation did not change in those on the low-fat diet (LFD) compared with those on the carbohydrate-restricted diet, despite the equivalent energy, but there was a greater rate of body fat loss. In contrast, another study showed that those who consumed a low-carbohydrate diet for 12 months had a significant decrease in body weight and fat mass compared with those who consumed a low-fat diet (Bazzano et al., 2014). The same contradiction exists in the relationship between low-carbohydrate diets and fasting blood glucose, serum insulin and other glucose parameters. A decline in body weight, HbA1c and fasting plasma glucose levels was observed in people with HbA1c levels of 6.0-6.9% who were not receiving diabetes treatment compared with the control group (no change in diet) after consuming less than 40 g of carbohydrate per day for 6 months (Dorans et al., 2022). On the contrary, no significant difference in serum glucose and insulin levels was observed in the low-carbohydrate and low-fat diet groups over 12 months in the study by Bazzano et al. (Bazzano et al., 2014). A meta-analysis of 13 randomised controlled trials comparing low-carbohydrate diets with low-fat diets for at least 12 months showed significant reductions in body weight, triglycerides and diastolic blood pressure in those on very low-carbohydrate diets compared with those on low-fat diets (Bueno et al., 2013). A systematic review and meta-analysis of 22 randomised controlled trials

in South Africa showed that high carbohydrate intake (compared with low carbohydrate intake) was associated with a small increase in the risk of obesity.

Limitations of the study included the non-standardised categorisation of dietary intake across studies and confounding factors such as total energy intake, activity level, age and sex (Sartorius et al., 2018). Therefore, further studies are needed to classify carbohydrate intake by type in detail and to examine the direct effect of dietary carbohydrate ratios on insulin secretion and its relationship with obesity.

When healthy eating recommendations are followed, even in the absence of energy restriction (regardless of diet type), individuals' daily energy intake decreases by an average of 500-600 kcal (Gardner et al., 2018). In addition, the low-carbohydrate diet contains less simple sugars than the control group due to carbohydrate restriction, so the glycaemic load is low and energy intake is significantly reduced (Dorans et al., 2022). Moreover, energy restriction is applied to individuals in the studies (Hall et al., 2015; Tricò et al., 2021). Therefore, it is difficult to interpret the insulinaemic effect of diet alone, independent of the energy intake of the carbohydrate insulin model under these conditions. In this case, studies evaluating the carbohydrate ratio or glycaemic load of the diet without energy restriction/alteration are needed. The American Diabetes Association has published a guideline for adults with type 2 diabetes that includes low and very low carbohydrate dietary patterns (Siverhus, 2019). This guideline includes low-very low-carbohydrate dietary patterns and plans of experts in adults with type 2 diabetes. According to European recommendations, there are relationships between very low carbohydrate ketogenic diets and hypoglycaemia, ketoacidosis and vitamin-mineral deficiencies; also a relationship between extremely high carbohydrate or low carbohydrate dietarty approaches and high mortality (Aas et al., 2023).

The ESPEN 2021 guideline states that hospitalised patients with diabetes should avoid diets with a carbohydrate content of less than 40% of total energy intake, as this is associated with low energy intake and risk of malnutrition (Thibault et al., 2021). Although adaptation to long-term low-carbohydrate diets is not a problem (Ebrahimpour-Koujan et al., 2019), as they generally have short-term metabolic benefits and are of limited efficacy and practicality in the long term (Barber et al., 2021), it is important for professionals to be aware of these issues when applying low-carbohydrate diets to obese people and people with type 2 diabetes.

4.2. Carbohydrate Quality

High quality carbohydrate sources (whole grains, legumes or fruits), low glycaemic index (GI) and glycaemic load (GL), high dietary fibre and low sugar content are the determinants of carbohydrate quality (Sievenpiper, 2020). Low-carbohydrate diets reduce the consumption of whole grains, which are a source of high-quality carbohydrates, and consequently reduce the daily intake of dietary fibre. Low-carbohydrate diets contain significantly fewer whole grains than diets with no restrictions on any food group (DASH diet, Mediterranean diet, etc.) (Turner-McGrievy et al., 2021). In addition, the group who were in low-carbohydrate diet had a lower total fibre intake comparing the low-fat diet group (Gardner et al., 2018). A systematic review and meta-analysis

conducted to identify markers that explain the association between carbohydrate quality and health found that high dietary fibre intakes have significant benefits in protecting against type 2 diabetes, cardiovascular disease and cancer, and that body weight, blood pressure and total cholesterol levels benefits in protecting against type 2 diabetes, cardiovascular disease and cancer, and that body weight, blood pressure and total cholesterol levels decreased significantly with increasing dietary fibre intake (Reynolds et al., 2019). As dietary fibre is thought to regulate glucose and lipid parameters in individuals by supporting the gut microbiota through the production of short-chain fatty acids (Cronin et al., 2021) daily fibre consumption is particularly important in the prevention of obesity and obesity-related diseases.

In a review of carbohydrate quality studies in the literature, HOMA index, serum diacylglycerols and triacylglycerols, insulin, leptin and proinflammatory cytokines increased more in rats fed a high GI diet for 4 weeks than in those fed a low GI diet. In addition, an increase in fatty liver and overall adipose tissue was observed in obese rats fed rapidly digested carbohydrates (Manzano et al., 2022). In a randomised trial of 121 mildly obese adults, those fed a low-GI diet for 6 months had greater weight loss and greater progression in insulin resistance and sensitivity comparing low-fat diet group (Juanola-Falgarona et al., 2014). It is thought that low glycaemic index diets increase pregnancy rates in women and have an effect on the weight of babies to be born when used during pregnancy. A study of adult women who were with a body mass index (BMI) of 25-40 kg/m^2 undergoing In Vitro Fertilisation (IVF) reported that a hypocaloric low-glycaemic index diet improved oocyte development and pregnancy rates (Juanola-Falgarona et al., 2014).

As a result of a meta-analysis of 5 randomised controlled trials and 302 participants, it was reported that low glycaemic index diets contributed to a reduced risk of macrosomia in patients with gestational diabetes compared with the control group.

It was also reported that low glycaemic index diets with added dietary fibre further reduced the risk of macrosomia (Wei et al., 2016). According to these results, focusing on the quality of carbohydrates in the diet seems to be more beneficial than focusing on the quantity of carbohydrates (Sievenpiper, 2020).

4.3. Carbohydrate Insulin Model-Energy Balance Model

As shown in Figure 1, it has been reported that unhealthy dietary patterns can trigger either inflammatory or insulinaemic responses in the development of obesity and type 2 diabetes; with this view, the EBM shows the inflammatory response of individuals to diet, while the CIM explains the hormonal and metabolic responses. Evaluating these models together, rather than comparing them, may be a more accurate approach to assessing the development of obesity and associated diabetes (Ss, 2023). It has also been suggested that diets that focus on dietary models (taking into account the quality of carbohydrates) rather than a single type of diet are more appropriate (Sievenpiper, 2020). For the prevention of obesity and its complications, it seems more appropriate to develop individual dietary plans under the guidance of a dietician.

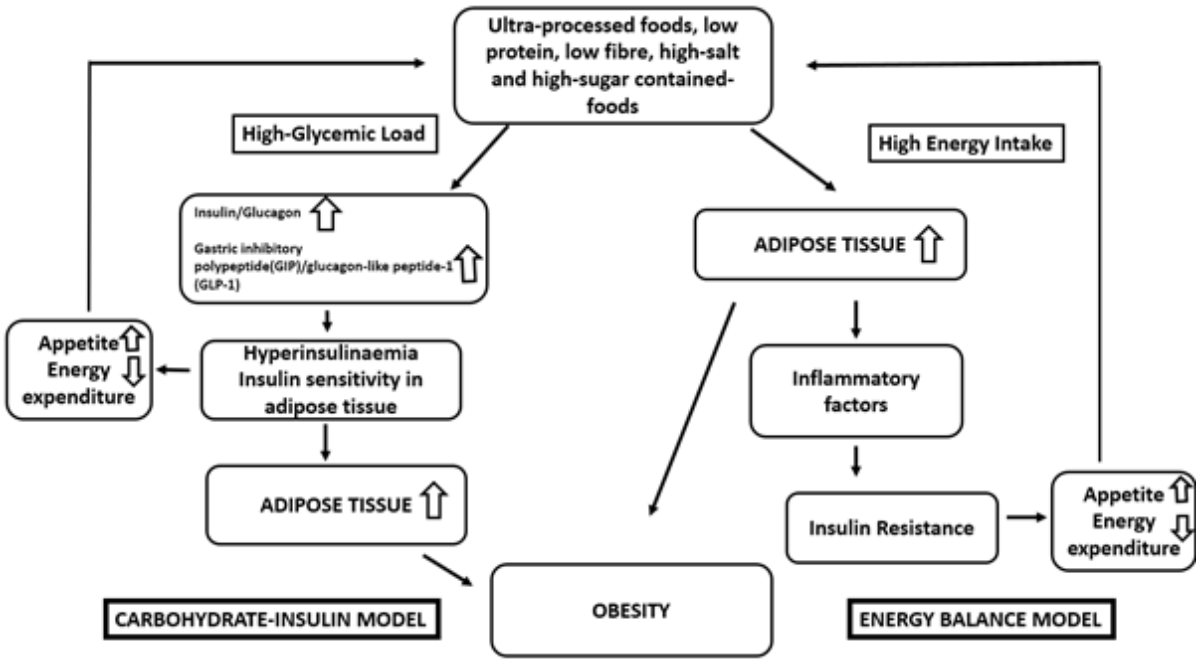

Figure 1. Causal Approaches of Obesity

The figure was adapted from Ludwig DS, Aronne LJ, Astrup A, de Cabo R, Cantley LC, Friedman MI, et al. (2021) The carbohydrate-insulin model: a physiological perspective on the obesity pandemic. Am J Clin Nutr.114(6):1873-85 and Ludwig DS, Apovian CM, Aronne LJ, Astrup A, Cantley LC, Ebbeling CB, et al. (2022) Competing paradigms of obesity pathogenesis: energy balance versus carbohydrate-insulin models. Eur J Clin Nutr. 76(9):1209-21. Adapted with permission.

4.4. Long-Term Risk Assessment of Low Carbohydrate Diet and The Importance of Personalised Diets

Low-carbohydrate diets are promoted in CIM in order to reduce the hyperinsulinemic effect. Some studies indicate beneficial metabolic effects of low-carbohydrate diets (Bazzano et al., 2014; Dorans et al., 2022), yet a contradictory finding exists as well (Hall et al., 2015). First of all, there is a lack of standardization of carbohydrate classification in studies (Feinman et al., 2015). This makes it difficult to compare low-carb diets with other dietary models, which in turn makes it difficult to explain the CIM approach.

Second, low-carbohydrate diets pose sustainability concerns because they increase the proportion of the diet coming from protein and fat. Low-carbohydrate diets cause some side effects, such as fatigue, headache and muscle pain, and serious side effects, such as ketoacidosis (Teicholz et al., 2025). Carbohydrate restriction may also result in low intakes of dietary fibre, minerals, vitamins, trace elements and PUFAs (Sampaio, 2016).

Moreover, It may cause a decrease in dietary fiber, mineral, vitamin, trace element and PUFA intake due to carbohydrate restriction (Sampaio, 2016). Another concern is the negative lipid response that can occur with low-carbohydrate diets, which is an increase in LDL cholesterol (LDL-C).

Although a systematic review and meta-analysis found no significant difference in serum LDL-C in people on a 20-40% carbohydrate diet for up to 24 months (Teuta et al.,2019), dietary saturated fat should be considered as it poses a risk for cardiovascular disease. Finally, it is necessary to take into consideration both the economic and environmental damages of increased meat consumption due to carbohydrate restriction (Barber, 2021).

Given these potential outcomes, personalized nutrition planning should prioritise individual health status, metabolic needs, lifestyle and preferences. Since a uniform diet will not be effective in the long term, a dietitian plays an important role in evaluating components such as genomes, gut microbiota, health biomarkers, socio-economic and cultural factors when designing a diet (Chen & Chen, 2022). This is because while restricting carbohydrates in the diet, it is also necessary to maintain adequate levels of fibre, vitamins, minerals and essential fatty acids. A study of 800 people between the ages of 18 and 70 reported that personalized dietary interventions, rather than general recommendations, can lead to lower postprandial glycaemic responses and positive changes in gut microbiota (Zeevi et al., 2015). In addition to the creation of personalized diet plans, individual self-monitoring of diet and follow-up is also important for research results (Popp et al., 2022).

5. Conclusion

Very low-carbohydrate diets have been associated with several concerns regarding their long-term sustainability, potential health risks, and economic as well as environmental implications. The long-term effects of such dietary patterns continue to be debated in the literature.

From a CIM perspective, diets rich in dietary fiber and low glycemic load carbohydrate sources may be considered more effective in obesity management compared to traditional low-carbohydrate approaches. Furthermore, the development of personalized dietary interventions by dietitians is essential for the effective treatment of obesity. However, further research is needed to evaluate and improve dietary patterns used to investigate the multifactorial causes of obesity.

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Conflict of Interest

There are no conflicts of interest to declare.

Author Contributions

BA contributed to research, article writing and figure creation. YA contributed to topic identification, writing process and evaluation.

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Review

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Effect of IL-34 on Macrophage Polarization

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Abstract

A cytokine recently found to play a role in monocyte survival has been termed interleukin 34 (IL-34). This cytokine plays a significant role in various physiological processes, including the regulation of cytokine and chemokine expression, differentiation of immune cells, and cell proliferation. In pathological conditions, IL-34 may mirror the pathophysiology of the disease involved, and simultaneously promote the growth and survival of myeloid cells, thereby maintaining homeostasis in the body. Increased levels of IL-34 have been shown in inflammation, autoimmune diseases, infections, and cancer. However, some studies reported that decreased levels IL-34 can be associated with several conditions such as neurological diseases.IL-34 macrophage phenotype is controlled with an immunosuppressive activity. Macrophages are heterogeneous both in function and phenotype. Depending on its biological characteristics and activity on macrophage polarization, IL-34 has been believed to have a therapeutic potential in the treatment of some diseases. The aim of this review is to discuss the role of IL-34 on macrophage polarization.

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1. Introduction

Cytokines are low-molecular-weight soluble proteins (6–70 kDa). Both prognostic and diagnostic information regarding disease may be obtained from cytokine concentrations in body fluids (Liu et al., 2021). Based on their functional characteristics, cytokines may be pro- or anti-inflammatory (Sprague & Khalil, 2009). Pro-inflammatory cytokines possess the ability to activate immune cells and trigger inflammatory responses. Anti-inflammatory cytokines function by inhibiting the number of immune cells and thereby suppressing or preventing inflammation. It is noteworthy that certain cytokines possess a dual role, having both pro-inflammatory and anti-inflammatory functions simultaneously (Monastero & Pentyala, 2017).

In the preceding fifteen years, several cytokines have been identified. Many of these have been shown to play a significant role in human disease and the immunological response. However, the genes encoding the recently identified cytokines IL-31, IL-32, IL-34, and IL-40 cannot be categorized into any cytokine superfamily (Catalan-Dibene et al., 2018). The purpose of this review is to investigate IL-34 and its effect on macrophage polarization.

2. IL-34

IL-34 is a cytokine which increases the growth and maturation of monocytes/macrophages via the colony stimulating factor-1 receptor (CSF-1R). The activation of CSF-1R, which is expressed in monocyte and macrophage progenitors, is essential for their development, survival, and function (Stanley & Chitu, 2014). Both CSF-1 and IL-34 which were discovered in 2008, have been proven to induce the activation of CSF-1R (Baghdadi et al., 2018). IL-34 has no apparent structural motif similarity with other cytokines and shares no sequence similarity with any other growth factor, including CSF-1 (Franzè et al., 2020). IL-34 is secreted as a non-covalently bound homodimeric glycoprotein and binds to the same sites of the CSF-1R as CSF-1, leading to phosphorylation and homodimerization of the receptor (Lelios et al., 2020).

2.1.Biological properties of IL-34

2.1.1. Receptors of IL-34

The primary IL-34 receptor is CSF-1R (Guillonneau et al., 2017). Depending on the type of cell, IL-34 and CSF-1 can trigger distinct biological processes and activate distinct signaling pathways, while sharing the same receptor. The two cytokines' distinct hydrophobic/hydrophilic interactions with CSF-1R (Franzè et al., 2020). Additionally, IL-34 has been observed to bind to syndecan-1 and receptor-type protein tyrosine phosphatase-zeta (PTP-ζ) to carry out its biological actions (Nandi et al., 2013; Segaliny et al., 2015). Engagement with CSF-1R has been demonstrated to trigger numerous signaling pathways that regulate cellular survival, proliferation, and differentiation (Baghdadi et al., 2018). IL-34 has also been shown to inhibit cellular processes and proliferation by attaching itself to PTP-ζ (Nandi et al., 2013).

2.1.2. The expression and secretion of IL-34 in tissues in health and disease

As shown in experiments with transgenic mice, IL-34 mRNA was expressed at tissue level in the skin,

brain, kidney, and testis (Wang et al., 2012). IL-34 mRNA has been shown to be present in human tissues like the heart, brain, liver, kidney, spleen, thymus, testis, ovary, small intestine, prostate, and colon. Additionally, cell studies confirmed the expression of IL-34 mRNA in a variety of cells, including cancer cells, neurons, macrophages, adipocytes, epithelial, and endothelial cells (Lin et al., 2008). Spleen, kidney, brain and skin tissue have been noted to express highly the IL-34 protein (Uhlen et al., 2015).

By using in vitro experiments, it has been established that proinflammatory cytokines such as tumor necrosis factor alpha (TNF-α), IL-1β, cisplatin, doxorubicin, pathogen-associated molecular patterns, and vitamin D may induce the release of IL-34 (Baghdadi et al., 2018). Bone morphogenetic protein-2 and transforming growth factor-beta1 (TGF-β1) have been observed to inhibit the release of IL-34 by synovial fibroblasts and mesenchymal stem cells (Chemel et al., 2017).

There are cell type-specific regulatory pathways found for the secretion of IL-34 have been. From studies conducted on HEK293 cells, epidermal tissue lysates, and periodontal ligament, it has been shown that intracellular IL-34 was secreted (Baghdadi et al., 2018; Kawabe et al., 2015; Schuster et al., 2014). Body fluids of serum/plasma, cerebrospinal fluid, synovial fluid, and saliva contain IL-34. In a study, serum IL-34 levels of 78 SLE patients and 53 healthy controls were compared, and serum IL-34 levels of SLE patients (median 128.9 pg/mL) were found to be significantly higher than those of healthy controls (median 52.4 pg/mL)(Wang et al., 2016).

IL-34 expression depends on pathological conditions. Prevalence of conditions like autoimmune diseases, inflammation, infections, metabolic disorders and cancer have been found to have enhanced expression of IL-34. Conversely, atopic dermatitis, Alzheimer's disease, and viral infections like hepatitis B virus have been associated with reduced expression of IL-34. It is hypothesized that there is a significant correlation between fluctuations in IL-34 expression and the pathogenesis, progression and severity of diseases. It has been documented that secreted IL-34 may serve as a potential biomarker to predict disease progression or response to treatment (Baghdadi et al., 2017).

2.1.3. Effects of IL-34 in cells

Intracellular IL-34 is essential for the continuous self-renewal of Langerhans cells and the survival of microglia (Lelios et al., 2020). Via binding to CSF-1R, it promotes proliferation and survival in myeloid serial cells, endothelial cells, fibrocytes and cancer cells expressing CSF-1R (Baghdadi et al., 2018). It also inhibits proliferation in cells such as glioblastoma cells through a PTP-ζ-dependent mechanism (Nandi et al., 2013). With the presence of GM-CSF, IL-34 can differentiate Kupffer cells and monocytes into immunosuppressive macrophages type M2 and differentiate monocytes to microglia-like cells as well as induce osteoclastogenesis (Amos et al., 2017; Chen et al., 2011; Zhao et al., 2018). IL-34 enhances migration and adhesion of monocytes to endothelial cells. It has pro-angiogenic effects for the promotion of vessel formation in tumors (Ségaliny et al., 2015). It facilitates the inflammatory cycle by triggering the expression of pro-inflammatory cytokines in various types of cells(Baghdadi et al., 2017; Guillonneau et al., 2017). Finally, neuronally expressed IL-34 in a

constitutive fashion, shields microglia and the blood-brain barrier following brain injury (Luo et al., 2013).

2.2.Patho-physiological properties of IL-34

As demonstrated by several studies, IL-34 is involved in pathological diseases(Baghdadi et al., 2017). It has been proposed that the cellular origin of the disease, the density of IL-34 receptors, and the microenvironmental mediators may all affect this impact (Baghdadi et al., 2018). According to recent reports, IL-34 may occasionally reverse the harmful impact, even if its function in the development of the pathological state has been established (Walker et al., 2017). Consequently, IL-34's function in diseases may be intricate and heavily influenced by the microenvironment.

2.2.1. IL-34 in inflammation

IL-34 has been found to induce inflammation, and NF-κB, the center of inflammatory pathways, is also activated by conditions that induce NF-κB (Yu et al., 2014). The reduction in intracellular IL-34 expression in cells when NF-κB is inhibited suggests that NF-κB plays a role in IL-34 expression (Eda et al., 2011). Elevated expression of IL-34 has been observed in many inflammatory diseases (Chang et al., 2014; Fan et al.; Shoji et al., 2016). By inducing pro-inflammatory cytokine production and inflammatory cell infiltration, IL-34 has been reported to amplify the inflammatory cycle (Franze et al., 2016; Franze et al., 2015).

2.2.2. IL-34 in autoimmune diseases

IL-34 has also been investigated for autoimmune connective tissue disorders. Blood, synovial fluids, and synovial tissues of several biological specimens of patients with rheumatoid arthritis have been found to contain increased levels of IL-34. Serum samples of patients with systemic lupus erythematosus patient serum and clinical samples of patients with Sjögren's disease have also been found to contain increased levels of IL-34 (Ge et al., 2019; Wang et al., 2016; Zhang et al., 2015).

2.2.3. IL-34 in infections

It has been demonstrated that viral proteins induce macrophages to produce elevated levels of IL-34 (Covaleda et al., 2010). By polarizing M2 macrophages, these elevated levels of IL-34 render humans more vulnerable to infection by the influenza A, hepatitis C, and Human Immunodeficiency Virus. Consequently, it is believed that inhibiting IL-34 in these individuals may help to control anti-infective immune responses (Guillonneau et al., 2017). However, in the context of bacterial and certain other viral infections, IL-34 has been shown to support protective responses (Cheng et al., 2017).

2.2.4. IL-34 in neurological diseases

Macrophages that are unique to the central nervous system and which have the capacity to differentiate are known as microglia. These cells exhibit distinct activation phenotypes in response to various triggering circumstances, including injury, infection and neurodegeneration, and thus have the potential to exert both positive and negative consequences. Through its modulation of microglial activities, IL-34 is suggested to have an anti-inflammatory and reparative character. A clinical study employing human brain samples demonstrated a reduction in IL-34 expression in Alzheimer's patients. The main rise

in the levels of the proinflammatory cytokines IL1B, TNF, IL6, IL8, and IL1A, along with the decrease in SEPP1 and TLR5, supports the idea that IL-34 and CSF-1 mainly cause inflammation in microglia. (Walker et al., 2017).

2.2.5. IL-34 in cancer

IL-34 has been found to induce macrophages into a tumor-associated macrophage (TAMs) phenotype that has been proven to suppress the immune response. A correlation of the prognosis with worse effects and with the quantity of these cells within the tumor microenvironment has been established. TAMs are M2 polarized macrophages that inhibit angiogenesis, tumor metastasis and immune responses (Franze et al., 2021; Franzè et al., 2020). Because of its influence on myeloid cells and tumor cells bearing its receptor, IL-34 may possess a pro-tumorigenic effect. A study which analyzed samples from tumor and normal tissues of 26 patients who underwent colon cancer surgery showed that IL-34 was overproduced in tumor tissue and it increased proliferation and invasion in cancer cells (Baghdadi et al., 2018; Nian et al., 2024). Through a syndecan-1 pathway, it has been shown to greatly promote the migration of THP 1 cells, a human acute leukemia cell line (Segaliny et al., 2015).

3. Macrophage

Peripheral blood monocytes are drawn to the site of inflammation following injury, infection, or sterile inflammation. Upon resolution of the inflammatory phenomena, they mature into resident macrophages and play a role in resolving inflammation and tissue repair (Gordon & Pluddemann, 2017; Mass et al., 2023). Monocyte-derived macrophages are terminally differentiated but those from embryonic tissues still have the ability for self-renewal (Hashimoto et al., 2013; McGrath et al., 2015). Human tissue cell turnover has been approximated at one million cells per second per day and macrophages play a central role in the phagocytic clearance of dying cells. In this phase, the most remarkable point is the majority of anti-inflammatory cytokines (Han & Ravichandran, 2011).

Phagocytosis is a vital function of macrophages, which utilize this process for eliminating infections and cellular debris (Davies et al., 2013). The availability of non-specific receptors on macrophages enables them to identify and attach such structures. These receptors facilitate the identification of host-owned and alien self-ligands that have undergone modification (Gordon, 2016). Macrophages are localized in the tissue, release and produce specific mediators when stimulated. These include chemokines such as CXCL8 and pro-inflammatory cytokines such as IL-1β, TNF-α, IL-6, and IL-12 (Arango Duque & Descoteaux, 2014).

3.1. M1/M2 macrophage polarization

Immunoregulatory mediators and the microenvironment have the capacity to shift the macrophage functional phenotype instantaneously. This phenomenon may be referred to as polarization. The existence of both M1 and M2 macrophages characterizes polarization. M2 macrophages have anti-inflammatory activities, while the M1 macrophages have pro-inflammatory characteristics (Table 1) (Galván-Peña & O'Neill, 2014; Viola et al., 2019). Interferon gamma (IFN-γ) and TNF-α have also been observed to activate M1 macrophages, and

Table 1. A schematic summary of macrophage polarization (Viola et al., 2019)

Polarization	Stimuli	Released cytokines	Surface markers	Metabolic enzymes	Transcription factors	Functions
M1	LPS+ IFN-γ	TNF-α, IL-1β, IL-6, IL-12, IL-23	CD80, CD86, CIITA, MHC-II	iNOS, PFKFB3, PKM2, ACOD1	NF-kB (p65), STAT1, STAT3, IRF-4, HIF1a, AP1	Bacterial killing, Tumor resistance, Th1 response
M2a	IL-4/ IL-13	IL-10, TGF-β	CD206, CD36, IL1Ra, CD163	ARG1, CARKL	STAT6, GATA3, SOCS1, PPARγ	Anti-inflammatory response, Tissue remodeling, Wound healing
M2b	Immune complex, TLR ligands/ IL-1Ra	IL-10, IL-1β, IL-6, TNF- α	CD86, MHC II	ARG1, CARKL	STAT3, IRF4, NF-kB (p50)	Tumor progression, immunoregulation, Th2 response
M2c	Glucocorticoids/ IL-10	IL-10, TGF- β	CD163, TLR1, TLR8	ARG1, GS	STAT3, STAT6, IRF4, NF-kB (p50)	Phagocytosis of Apoptotic bodies, Tissue remodeling, Immunosuppression
M2d	TLR ligands + A2R/ IL-6	IL-10, VEGF	CD206, CD204, CD163	ARG1, IDO	STAT1, IRF3, NF-kB (p50)	Angiogenesis, tumor progression

the latter have been reported to contain low amounts of IL-10 and high amounts of pro-inflammatory cytokines. M1 macrophages can be tissue-damaging in potentiality, particularly during resolution of inflammation, unless tissue repair is sufficiently begun in a timely or adequate way. Cytokines IL-4 and IL-13 are responsible for M2 macrophage polarization. They have the capacity to actively inhibit inflammation, heal, and secrete pro-fibrotic substances like insulin-like growth factor 1 (IGF-1) and transforming growth factor-beta (TGF-β) (Gordon & Martinez, 2010; Wang et al., 2014).

Several triggers have been identified that can activate M2a macrophages including TGFβ, IL-10, immune complexes, and glucocorticoids (Rőszer, 2015). The M2b (regulatory) macrophage, on the other hand, secretes pro- and anti-inflammatory cytokines in response to immune complexes, Toll-like receptor (TLR) ligands, or IL-1R agonists (Wang et al., 2019). The M2c subset, on activation by glucocorticoid or IL-10, secretes TGF-β and IL-10 and possesses an intense anti-inflammatory phenotype (Yadav et al., 2023). A2R agonists, TLR ligands, and IL-6 were found to activate M2d macrophages, or TAM. M2d macrophages were found to secrete low amounts of IL-12, TNF-α, and IL-1β, but simultaneously produce high amounts of IL-10, TGF-β, and vascular endothelial growth factor (VEGF) (Gordon & Martinez, 2010; Li et al., 2021).

4. Effect of IL-34 on macrophage polarization

Like CSF-1, IL-34 promotes the development of human monocytes and their differentiation into macrophages. Signaling and polarization of macrophages differentiated by both these two cytokines also differ in certain ways (Muñoz-Garcia et al., 2021). For instance, compared to CSF-1, IL-34-stimulated macrophages produce higher levels of eotaxin-1, IL-10, and CCL17. It has been reported that IL-34 triggers caspase and autophagy pathways in monocytes, which are necessary for macrophage polarization (Boulakirba et al., 2018; Chihara et al., 2010). These differentiated macrophages inhibit the immune system by suppressing T cell proliferation and poor stimulation of T cells.

M2 macrophages were discovered to exert a detrimental effect on certain tumors, even though they can modulate immune responses. It is well established that IL-34 can cause the production of macrophages (M2d) that phenotypically and functionally resemble TAMs (Foucher et al., 2013). IL-34 was discovered to possess pro-tumorigenic activity in several cancer types. For instance, it has been implicated in chemoresistance and poor prognosis in lung cancer, colon cancer, and malignant pleural mesothelioma. In line with this, it has been hypothesized that IL-34 has a role in the acquisition of resistance to therapy (Endo et al., 2020). It is therefore important to analyze the levels of IL-34 production in different tumor types.

IL-34 was found to cause differentiation of diverse cell types. In bone degenerative diseases, pro-inflammatory cytokines were found to increase osteoclast generation and activation. Research indicated that IL-34 is expressed by gingival fibroblasts, and that IL-34 expression is elevated when cytokines such as TNF-α and IL-1β stimulate gingival fibroblasts. Therefore, it has been implicated that IL-34 may play a role in osteoclastogenesis and inflammation in degenerative diseases, including

periodontitis (Boström & Lundberg, 2013). In addition, it was illustrated that IL-34 induced differentiation of acute myeloid leukemia cell lines U937, HL-60, and THP-1 into monocyte-like cells (Booker et al., 2015).

Regulatory T cells (Tregs) are key to the suppression of inflammatory and autoimmune disease. Evidence suggests that Tregs can express IL-34, and IL-34+ Tregs have been found to be linked with more vigorous immunoregulatory function. The therapeutic potential of Treg induction to control anti-graft immune responses in transplant recipients, as well as in experimental allograft models, is under exploration. Treg cells and M2 macrophages are believed to have a crucial anti-inflammatory function in organ transplantation as well as in other diseases (Bézie et al., 2015; Hu et al., 2020).

5. Conclusion

In summary, IL-34 has been identified as a novel macrophage polarization regulator and may be of therapeutic benefit in certain pathologies. The therapeutic benefit of the administration of recombinant IL-34 in diseases where IL-34 is beneficial, and the use of IL-34 inhibitory antibodies in diseases where IL-34 is detrimental, has been demonstrated (Freuchet et al., 2021; Ge et al., 2019; Wang et al., 2025). The hypothesis that suppressing the production of inflammatory cytokines and promoting the growth of M2 macrophages and Treg cells within inflammatory sites would promote healing comes from existing evidence (Baghdadi et al., 2018). One of the identified strategies is IL-34 polarization of macrophages. It has also been speculated that IL-34 may enhance graft survival by favoring immunological tolerance during transplantation and that IL-34 might be employed in cell therapies to augment Treg cells (Freuchet et al., 2022; Kim & Turka, 2015). IL-34 blockade, through its reduction of TAMs, can aid anti-cancer therapy (Monteleone et al., 2023). It has been proposed that the compound may have therapeutic value in tissue homeostasis recovery following injury since it is biologically essential for Langerhans cell and microglia development (Guilliams et al., 2020). There is potential for developing new therapeutic strategies for neurodegenerative disorders, including Alzheimer's and multiple sclerosis (Koronyo-Hamaoui et al., 2022).

Ethical Statement

There is no need to obtain ethics committee permission for this review article. However, the study was conducted in accordance with ethical principles.

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Conflicts of Interest

The authors declare no conflicts of interest regarding this study. Any institution or organization providing funding for this research did not have any role in the design, data collection, analysis, interpretation, or publication to influence or distort the findings.

Author Contributions

The contributions of the authors are as follows: M.S. participated in plan and design; R.K. participated in writing and correction of the manuscript.

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Review

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The Role of Pediatric Nurses in the Effectiveness of School-Based Emotion Regulation Programs on Anxiety, Depression, and Well-Being

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Abstract

Adolescence is a developmental stage characterized by intense emotional fluctuations and heightened psychological sensitivity. Acquiring effective emotion regulation skills during this period plays a critical role in preventing internalizing problems such as anxiety and depression. This systematic review examines the impact of school-based emotion regulation interventions on adolescents' psychological well-being, anxiety, and depression levels, and discusses the role of pediatric nurses in these programs. The findings indicate that structured intervention programs are effective in reducing psychological symptoms and promoting positive attributes. These interventions include cognitive behavioral therapy, mindfulness-based approaches, psychoeducation, and physical activities. Pediatric nurses contribute significantly in this process through their roles as educators, counselors, caregivers, protectors, and innovators. Particularly in school-based interventions, they can guide students in developing emotional awareness, enhancing coping skills, and fostering healthy social relationships. In conclusion, increasing the visibility and functionality of pediatric nurses in school-based mental health services presents a valuable opportunity to strengthen the community's overall psychological well-being.

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1. Introduction

Adolescence is a developmentally complex and sensitive stage during which individuals undergo multidimensional changes as they transition from childhood to adulthood. In this process, they are confronted with developmental tasks such as forming their identity, gaining independence, and defining their social roles (McLaughlin et al., 2015). Increasing social awareness, environmental expectations, academic responsibilities, and the transformation of peer relationships bring both supportive and challenging conditions for psychological adjustment. Developmentally, this period is marked by intensified questioning of both the external world and internal experiences; young individuals become more sensitive to life events and more open to the search for meaning (Huttunen et al.,2025; Long et al., 2020).

During this period, emotions become more intense, variable, and difficult to manage. Especially in this phase where social interactions increase and self-awareness develops, the individual is responsible not only for understanding their own emotions but also for recognizing and appropriately responding to the emotions of others (Selcuk & Aslan, 2022; Silvers, 2022). Developing emotion regulation skills can have a protective effect against mental health problems. This skill significantly ensures adolescents' psychosocial well-being (Verzeletti et al., 2016; Young et al., 2019). Furthermore, promoting positive emotions strengthens an individual's psychological and emotional well-being (Rana & Nandinee, 2016).

Findings in the literature indicate that adolescents with effective emotion regulation skills exhibit higher psychological adjustment and are less affected by internalizing problems such as depression and anxiety (Aldao et al., 2010; Kokonyei et al., 2024). Emotion regulation skills support individuals in making healthier decisions across various areas of life, engaging in more adaptive social interactions, and forming a stronger sense of self during personal development (Compas et al., 2017; Silvers, 2022). Therefore, equipping adolescents with effective emotion regulation strategies at an early age should be considered not only a mental health intervention but also a developmental necessity.

In this context, school-based emotion regulation programs have become effective tools to enhance emotional resilience, prevent psychological problems, and support social adjustment in young individuals. Evaluating the effects of these programs, which aim to strengthen emotion regulation skills, on depression, anxiety, and well-being is crucial for both health and education professionals. This systematic review aims to examine the effects of school-based emotion regulation interventions for adolescents on anxiety, depression, and well-being, and to highlight the role of pediatric nurses in these interventions. Accordingly, the article addresses the topic under the following subheadings: school-based interventions designed to protect adolescents' psychosocial health, the importance of emotion regulation in adolescence and emotion regulation programs, the impact of these programs on anxiety, well-being, and depression, and the relationship between emotion regulation and pediatric nursing.

2. School-Based Interventions Aimed at Protecting the Psychosocial Health of Adolescents

The World Health Organization (2020) states that school-based psychosocial interventions targeting adolescents can help detect emotional or behavioral disorders at an early stage and prevent high-risk behaviors (The World Health Organization, 2020). These interventions are structured, multifaceted programs designed to support the mental well-being of children and adolescents, enhance their emotional resilience, and reduce psychological risks. They aim to positively influence not only students' individual development but also their social and academic progress. Interventions typically include cognitive behavioral therapy, mindfulness-based practices, psychoeducation, physical exercise, breathing exercises, and relaxation techniques (Caldwell et al., 2019; van Loon et al., 2020).

One such approach, cognitive behavioral interventions, helps students recognize negative thought patterns, develop healthy coping mechanisms, and manage their emotions more functionally. This, in turn, strengthens their self-confidence and improves their ability to cope with psychological symptoms (de la Torre-Luque et al., 2020; Essau et al., 2019). Mindfulness and relaxation-based interventions focus on enhancing attention, increasing bodily awareness, and promoting relaxation through breathing exercises. These practices contribute to stress reduction, inner calm, and regulation of emotional responses (Areskoug Sandberg et al., 2024; Monsillion et al.,2023).

Psychoeducation programs equip students with fundamental psychological knowledge and skills such as recognizing and expressing emotions and seeking appropriate help. These programs also raise mental health awareness and support adolescents in making sense of the challenges they experience (Jordans et al., 2013; Stjernswärd & Hansson, 2014). Physical interventions, including exercise, breathing exercises, relaxation techniques, body movements, and increasingly common school-based yoga practices, aim to support stress management and enhance students' psychological well-being. In addition to improving physical flexibility and awareness, yoga offers a holistic approach that promotes mental calmness, concentration, and emotional balance, thereby supporting students' overall mental health (Khunti et al., 2023; Sanchez et al.,2023). Among these school-based interventions, another important category includes emotion regulation programs for adolescents (Pedrini et al., 2022).

3. The Importance of Emotion Regulation in Adolescents and Emotion Regulation Programs

Emotion regulation is a fundamental process that enables individuals to manage their emotional experiences healthily. This skill lies at the core of both social relationships and personal development, and it becomes particularly pronounced during adolescence (Mulyati et al., 2020; Young et al., 2019). Managing emotions appropriately encompasses multilayered skills such as increasing self-awareness of internal states, coping with emotional challenges, and maintaining behavioral control to achieve personal goals (Gross et al., 2015). Acquiring emotional regulation skills enhances individuals' flexibility and

psychological resilience in both positive and negative life experiences, thereby supporting overall well-being as a critical component of socio-emotional capacity (Morrish et al., 2018; Young et al., 2019). Unlike childhood, adolescents may face greater difficulties in coping with stress due to increased personal responsibilities and the pursuit of independence, which in turn amplifies their need for emotion regulation skills (Mulyati et al., 2020; Young et al., 2019). Therefore, it is recommended that structured intervention programs aimed at improving adolescents' emotion regulation skills be implemented during this developmental stage (Cracco et al., 2017; Eadeh et al., 2021; Pedrini et al., 2022; Theurel & Gentaz, 2018).

School-based emotion regulation intervention programs help adolescents manage and express their emotions, use positive coping strategies, show empathy, and maintain anger control (Carissoli & Villani, 2019; Claro, Boulanger, & Shaw, 2015; Daly et al., 2015; Frank et al., 2017; Houck et al., 2016; Rodríguez-Ledo et al., 2018). These programs may also contribute to reducing risky behaviors (such as smoking, alcohol, and substance use), aggressive tendencies, depressive symptoms, cyberbullying, attention problems, and stress levels among adolescents (Akdemir & Gunduz, 2022; Burckhardt et al., 2016; Fung et al., 2019; Iyer & Iyer, 2019; Lam & Seiden, 2020; Schoeps et al., 2018). This article will explore the effects of emotion regulation programs implemented among adolescents on anxiety, well-being, and depression.

3.1. The Effects of Emotion Regulation Programs on Anxiety, Well-being, and Depression

Emotion regulation has become a key focus of school-based interventions, leading to the development of numerous structured programs. The primary aim of these programs is not only to enhance emotion regulation skills in adolescents but also to reduce anxiety and depression levels and to improve psychological well-being. Programs based on Emotion Regulation (ER) and Behavioral Activation (BA), as evaluated by Johnstone et al. (2020), were found to be effective in reducing students' anxiety levels and contributed to the development of resilience skills (Johnstone et al., 2020). Similarly, the FRIENDS and My FRIENDS programs yielded successful results in decreasing general anxiety levels and particularly components such as worry (Kozina, 2020; Maalouf et al., 2020). Klim Conforti et al. (2021) noted that a Harry Potter-themed cognitive behavioral therapy training led to significant improvements in anxiety and social difficulties, especially among female students (Klim Conforti et al., 2021). The mindfulness-based L2B program implemented by Lam & Seiden (2020) also resulted in significant decreases in anxiety levels alongside improvements in emotional control and self-monitoring (Lam & Seiden, 2020). In another study, a mindfulness-based intervention conducted among adolescents with a history of addiction was shown to be effective in reducing impulsivity as well as managing anxiety. However, it was emphasized that longer-term interventions may be necessary for more complex skills such as emotion regulation and coping with stress (Russell et al.,2019).

In addition to reducing anxiety levels, supporting psychological well-being is also one of the key objectives of interventions. Brown et al. (2024) examined not only psychopathological symptoms in the DISCOVER program but also levels of well-being, stating that the program offers a comprehensive approach to enhancing adolescents' overall psychological health (Brown et al., 2024). James et al. (2024) demonstrated that the DISCOVER program facilitates coping with stress by improving emotion regulation skills, thereby contributing to psychological well-being (James et al., 2024). In another study, the D.N.A. program supported core psychological skills while addressing gaming addiction and enhanced psychological well-being (Cheng, Li, & Chen, 2024). A separate study on the Gaia program reported significant improvements in eudaimonic well-being components such as personal growth and life purpose; however, it was noted that the effects on areas like happiness and depression/anxiety were limited (Scafuto et al., 2024). Additionally, the MPPI program developed by Tejada-Gallardo et al. (2022) has the potential to reshape the complex relationship between well-being and psychological distress (Tejada-Gallardo et al.,2022). The DIALOG+S intervention also demonstrated positive effects on self-esteem, resilience, and quality of life (Gómez-Restrepo et al., 2023).

Significant findings have been reported among interventions directly targeting depression. Chen et al. (2024) emphasized that the M-SSL program was effective in reducing depressive symptoms and improving emotional challenges such as social anxiety (Chen et al., 2024).

In the Strong Minds program, the ACT-based intervention led to notable reductions in depression and stress levels (Burckhardt et al., 2016). The Harry Potter-themed intervention program also contributed to significant improvements in depression and self-evaluation (Klim Conforti, 2021). Online mindfulness- and ACT-based programs used in the studies of Lam and Seiden (2020) and Lappalainen et al. (2021) yielded promising results in reducing depressive symptoms and enhancing life satisfaction (Lam & Seiden, 2020; Lappalainen et al., 2021). The MindOut program, when implemented in disadvantaged schools, achieved short-term improvements in adolescents' mental health, including reductions in depressive symptoms (Dowling, 2019). Russell's research showed a decline in depression levels, particularly among youth with a history of substance use, where the intervention proved effective (Russell et al.,2019). On the other hand, the study conducted by Rice et al. (2024) did not identify any statistically significant differences between groups regarding depression, anxiety, or resilience levels (Rice et al., 2024).

However, not all interventions yielded the desired outcomes. Singh et al. (2019) observed no significant changes in social-emotional skills or depressive symptoms among students who participated in the Resilient Families program (Singh et al., 2019). The CERTIFY program developed by Claro and colleagues (2015) was found to be effective in enhancing emotion regulation skills but demonstrated limited impact on reducing risky behaviors (Claro, Boulanger, & Shaw, 2015).

4. Emotion Regulation and Pediatric Nursing

Pediatric nurses are responsible not only for the physical health of children and adolescents, but also for supporting their psychosocial development. In this context, especially in school-based interventions, pediatric nurses can guide students in areas such as emotional awareness, coping with stress, and developing social skills. These nurses, who are able to build trust with students and recognize their needs early to provide appropriate referrals, play a key role in protecting child and adolescent mental health (Lineberry & Ickes, 2015).

Pediatric nursing and school nursing are interrelated disciplines, and structured emotional support contributes to students feeling safe in learning environments, developing psychological resilience, and strengthening social connections (National Association of School Nurses, 2016). In this context, pediatric nurses in schools can undertake diverse roles such as individual counseling, group-based psychoeducational sessions, parent information activities, collaboration with teachers, and evaluation of intervention programs (Maughan et al., 2014).

The American Academy of Pediatrics emphasizes that school nurses play a central role in supporting the biopsychosocial health of children within the school environment. These nurses assume multifaceted responsibilities, including not only physical health monitoring but also promoting mental well-being, ensuring emotional safety, and providing social support (American Academy of Pediatrics, 2016).

Considering that emotion regulation skills, which develop especially during adolescence, are among the key determinants of mental health, the roles of the nurse as educator, counselor, caregiver, protector, and innovator become increasingly significant. In the educator role, pediatric nurses can guide adolescents and their families in recognizing, expressing, and appropriately managing emotions. Through their counseling role, they support adolescents who struggle with emotions such as stress, anger, and anxiety, and direct them to appropriate resources. Within the scope of protection and health promotion, the nurse identifies emotional difficulties at an early stage, creates an environment that fosters emotional well-being, and undertakes preventive actions against psychosocial risks. As a caregiver, the nurse provides a safe and supportive relationship context where adolescents feel free to express their emotions. Finally, in the role of innovator, the nurse contributes actively to the design and development of emotion regulation programs, including planning implementation and structuring intervention components (Al Sharif et al., 2024; Cracco et al., 2017; Lytle et al., 2024) (Figure 1).

Figure 1. Roles of Pediatric Nurses in Emotion Regulation Among Adolescents (Al Sharif et al., 2024; Cracco et al., 2017; Lytle et al., 2024)

Within this framework, pediatric nurses can take an active role in school-based or clinic-based intervention programs aimed at developing emotion regulation skills. In doing so, they contribute not only to individual-level preventive mental health services but also become key actors in community-based psychosocial support initiatives. In this respect, pediatric nurses are strategic contributors to mental health promotion not only at the individual level but also at school and community levels. Therefore, ensuring that pediatric nurses assume more visible, active, and competent roles in school-based emotion regulation programs is of critical importance for strengthening community mental health (Al Sharif et al., 2024; Lytle et al., 2024; Moen & Jacobsen, 2022).

Conclusion

Emotion regulation, which begins to develop in childhood and becomes more sophisticated during adolescence, plays a critical role in mental well-being. Supporting adolescents in developing healthy emotional regulation strategies through structured school-based interventions contributes not only to reducing symptoms such as anxiety and depression, but also to strengthening psychological resilience and well-being. Programs implemented in recent years, especially those based on mindfulness, cognitive-behavioral approaches, or psychoeducation, have shown promising results in improving adolescents' emotional skills.

In this context, the involvement of pediatric nurses in school-based emotional regulation programs is of great importance. Pediatric nurses, by supporting not only the physical but also the psychosocial development of children and adolescents, can assume effective roles in the design, implementation, and evaluation of intervention programs. Therefore, encouraging the inclusion of pediatric nurses in psychosocial school health practices will make significant contributions to both individual and community-level mental health promotion.

Ethical Statement

There is no need to obtain ethics committee permission for this study due review. However, the study was conducted in accordance with ethical principles.

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Presentation Information

The findings of this study have not been presented at any conference or journal.

Conflicts of Interest

The authors declare no conflicts of interest regarding this study. Any institution or organization providing funding for this research did not have any role in the design, data collection, analysis, interpretation, or publication to influence or distort the findings.

Author Contributions

The contributions of the authors are as follows: [Merve Oral, Ebru Kılıcarslan] participated in data collection and analysis; [Merve Oral] prepared the draft of the paper; [Merve Oral, Ebru Kılıcarslan] conducted the final revision of the manuscript.

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Review

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A Creative Approach to Enhancing Nurses' Mental Health: Art Therapy

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Abstract

The nursing profession carries significant mental health risks due to its high levels of stress and intense emotional demands. Factors such as the pandemic and staff shortages have increased nurses' workloads, leading to a rise in mental health issues such as burnout, anxiety, and depression. These mental health challenges negatively affect both individual well-being and the quality of patient care. In addition to traditional interventions, art therapy has emerged as a promising method to support nurses' psychological well-being. By utilizing creative processes such as painting, music, dance, and drama, art therapy helps individuals express their emotions, reduce stress, and enhance psychological resilience. Research shows that art therapy alleviates nurses' emotional burden, fosters self-awareness, and promotes psychological healing. This review discusses the mental health issues faced by nurses, the impacts of these issues, and the positive effects of art therapy on nurses' mental health based on scientific findings.

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1. Introduction

Nursing is considered as one of the professional groups with high risk in terms of psychological problems as it involves high levels of stress and frequent exposure to emotionally challenging situations (Rafiei et al., 2024). In addition to the difficulties that are inherent in the nursing profession, emergencies such as pandemics and lack of staff increase nurses' workloads and triggers the emergence of mental health problems (Berlin et al.,2023, Squires et al., 2025).

The prevalence of mental health problems among nurses is steadily increasing. According to an international study conducted across 35 countries, the rate of anxiety and depression among nurses ranges from 23% to 61%, while the rates of workplace burnout (fatigue), anxiety, and feelings of being overwhelmed are reported to be 57%, 44%, and 41%, respectively (Squires et al., 2025). Another study involving more than 7,000 nurses found that 56% experienced emotional burnout, and 64% reported very high levels of stress (Berlin et al., 2023). The widespread occurrence of mental health problems among nurses adversely affects their professional functioning (Rafiei et al., 2024). Therefore, the early diagnosis and intervention of psychological problems in nurses are significant for decreasing negative effects and developing effective intervention strategies (Rafiei et al., 2024; Yang et al., 2024).

In recent years, in addition to traditional psychological interventions that aim to support nurses' mental health, alternative and complementary therapeutic methods have gained attention. In this context, art therapy has emerged as a promising approach to help nurses cope with occupational stress and emotional challenges. Art therapy is a creative form of therapy which enables individuals to express their feelings and opinions through artistic processes. This type of therapy is guided by trained therapists (American Art Therapy Association, 2023). This method, which involves different artistic disciplines such as painting, music, dance, drama, and poetry, has the potential to reduce nurses' stress levels, enhance their emotional resilience, and support their psychological well-being (Malchiodi, 2013). The potential of art therapy to reduce anxiety, depression, and stress levels among nurses and to improve their mental health has recently been emphasized in growing number of studies (Ağaç et al., 2023; Zhang et al., 2024).

The aim of this review article is to evaluate the use of art therapy in solving mental health problems among nurses in light of scientific data.

2. Mental Health Problems Among Nurses and Their Impacts

Mental health of nurses has critical importance for the sustainability of global health systems and the quality of patient care. Recent studies have revealed that nurses bear a significant mental health burden, which negatively affects both their professional and personal lives (Berlin et al., 2023; Squires et al., 2025). The main factors that form the basis of nurses' mental health problems are shortage of personnel, high patient loads, lack of leadership, excessive administrative duties, workplace pressure, emotional burnout, irregular shift work, insufficient payment, and exposure to violence (Berlin et al., 2023; Rafiei et al., 2024). Common mental health problems among nurses include sleep disorders, stress, depression,

anxiety, post-traumatic stress disorder, cognitive issues, compassion fatigue, and feelings of being overwhelmed (Berlin et al., 2023; Squires et al., 2025; Yang et al., 2024; Zhang & Dator, 2025). These mental health problems are closely related to various modifiable risk factors such as nurses' behavioral patterns, their ways of life, the level of social support they receive, the level of workplace bullying and violence, shift work patterns, workload, and job resources (Rafiei et al., 2024; Yang et al., 2024; Zhang & Dator, 2025).

The mental health problems experienced by nurses significantly affect their job performance, the quality of patient care, and their personal lives (Berlin et al., 2023). Mental health issues such as lack of concentration, anxiety, fatigue, and feelings of being overwhelmed increase the possibility of nurses to make mistakes (Squires et al., 2025). In particular, psychological disorders such as post-traumatic stress disorder and depression negatively impact nurses' professional performance and lead to patient safety issues (Labrague et al., 2021; von Vogelsang et al., 2021). To cope with these adverse effects, individual and institutional interventions that support nurses' mental health are needed.

3. Interventions Supporting Nurses' Mental Health

Nurses try to deal with mental health problems on their own (Berlin et al., 2023; Reed et al., 2020). Nurses' individual coping strategies include exercises, spiritual practices, strengthening social support systems (Squires et al., 2025), lifestyle changes such as changes in diet and physical activity (Yang et al., 2024). For these individual coping strategies to be effective, it is essential for healthcare institutions to strengthen institutional support mechanisms. It is important to extend practices such as flexible working hours, counseling services, support groups, training programs, and appropriate nurse-patient ratios (Berlin et al., 2023; Labrague et al., 2021).

In addition, it is emphasized that awareness studies should be conducted to reduce mental health stigma, human-centered institutional policies should be developed, national-level monitoring systems should be established, and programs promoting peer support should be encouraged (von Vogelsang et al., 2021). It is suggested that when all these strategies are implemented, nurses' psychological well-being will increase, which will, in turn, have positive effects on the quality and safety of patient care (Squires et al., 2025).

The literature involves numerous systematic reviews that examined interventions to prevent burnout and enhance psychosocial well-being among healthcare workers (Cohen et al., 2023; Townsley et al., 2023). These interventions consist of a variety of strategies at both the individual and organizational levels such as educational programs, retreat-based practices, mindfulness-based stress reduction, cognitive training, workload adjustments, the enhancement of teamwork, and communication skills training (Cohen et al., 2023; Townsley et al., 2023). Art-based interventions offer nurses an experience that allows them to externalize their intense emotional burden while also enhancing self-awareness, self-compassion, and psychological resilience (Tjansik et al., 2023). In the literature, there is a growing body of

evidence indicating that art therapy-based group interventions improve nurses' ability to cope with occupational stress and help them develop new perspectives (Huet & Holttum, 2016). Moreover, art therapy has emerged as an effective method that supports emotional and psychological healing and enables nurses to cope with stress, learn emotion regulation method, and enhance personal resilience (Phillips & Becker, 2019). Therefore, the inclusion of art therapy approaches in mental health interventions for nurses and the expansion of their areas of application have become a significant need.

4. Definition and Benefits of Art Therapy

The American Art Therapy Association defines art therapy as "a holistic mental health profession that enriches the lives of individuals, families, and communities through active art-making, creative processes, applied psychological theory, and the psychotherapeutic relationship" (American Art Therapy Association, 2023). Art therapy is regarded not only as a means of communication but also as a psychotherapeutic approach that presents a visual language to individuals through which they can express complex emotions, thoughts, and experiences which they cannot express verbally (Çelikbaş, 2019). It is not necessary for an individual to be an artist or possess special skills to express themselves through art; the most important element is showing an open attitude toward creativity in everyday life (Vaartio-Rajalin et al., 2021).

Three general approaches are adopted in art therapy (Abbing et al., 2018). According to the first approach, art-making is used as an enjoyable and relaxing activity that creates a trance-like mental state. This leads to relaxation and contributes to stress regulation by lowering cortisol levels (Kaimal et al., 2016). The second approach perceives art as a means for expressing unconscious cognitive patterns and gaining insight; this process makes the unconscious visible and enables individuals to explore their emotions and cognitions. In this way, cognitive regulation is facilitated (Abbing et al., 2018). In the third approach, art is used as a process for the conscious expression of difficult emotions and traumatic memories. It supports exposure, remembering, and emotional distancing by providing a safe space. In this way, it contributes to better emotional regulation (Abbing et al., 2018). All of these approaches support the recognition and safe expression of challenging or suppressed emotions, offer individuals a secure environment where they can express themselves without judgment, and foster self-awareness and the development of psychological resilience (Van Lith & Spooner, 2018).

Art therapy is an effective psychotherapeutic method that enables individuals to express their inner worlds and contributes to emotional healing processes. When verbal communication is limited or insufficient, it allows individuals to express their emotions and thoughts through visual means. Art therapy offers several prominent benefits (Liebmann, 2004; Malchiodi, 2013):

- It offers individuals the opportunity for free expression without the pressure of artistic accuracy and facilitates the reactivation of artistic activities experienced during childhood.
- It provides an alternative communication channel for individuals who have difficulty with verbal expression and has the potential to simplify intense verbal account.
- It creates a safe space where individuals can express themselves without judgment and fosters self-awareness and the development of psychological resilience.
- Visual expression enables more direct and effective reflection of emotions and contributes to the exploration of the individual's inner world.
- The artworks that are produced serve as concrete and lasting records of the therapeutic process and become reflective communication tools between the client and the therapist.
- The process of creating art activates senses (touch, sight, etc.) and increases emotional and physical participation.
- It encourages the re-emergence of playfulness and creativity in adults and supports psychological relaxation.
- In group settings, it encourages equal participation and facilitates the active involvement of individuals with low motivation.
- Art provides catharsis and thus enables emotional release, reduces stress levels, and enhances overall well-being.
- In some cases, it can assist in the diagnostic process and be used in the assessment of certain psychological disorders.

5. Applications of Art Therapy

Art therapies are among the effective components of complementary medicine. These methods which include various creative disciplines such as drama/theatre, dance/movement, creative writing (poetry, storytelling, etc.), music, and visual arts (painting, sculpture, photography, etc.), are combined with psychotherapeutic principles to support individuals' physical, emotional, cognitive, and social well-being (Smriti et al., 2022). Art therapy can help individuals explore past and present experiences, review their lives, adapt to age-related changes, and cope with emotional crises (Vaartio-Rajalin et al., 2021).

Art therapy is widely applied both individually and in groups in various settings including hospitals, mental health centers, rehabilitation units, schools, and community centers (Van Lith & Ettenberger, 2023). It is emphasized that in all these settings, art therapy should be conducted under the guidance of a therapist and sufficient time must be spent for the verbal processing of emotions arising from the artistic experience (Vaartio-Rajalin et al., 2021).

Art therapy, which is an effective tool for processing various emotional difficulties, resolving conflicts, gaining insight, and enhancing psychological well-being (American Art Therapy Association, 2023),

provides strong support particularly for expressing experiences that are difficult to express verbally, such as physical or sexual abuse, grief, and trauma (Malchiodi, 2013). Studies have shown that art therapies have been successfully applied to healthy adults (Kaimal et al., 2016), individuals diagnosed with cancer (Jiang et al., 2020), anxiety and depression (Newland & Bettencourt, 2020), neurocognitive disorders (Liu et al., 2023), and mental disorders (Hu et al., 2021), as well as children and adolescents (Zhang et al., 2024b). Moreover, integrating art therapy with complementary methods such as mindfulness, meditation, yoga, and energy healing leads to a stronger mind-body connection in individuals and offers a holistic healing process (Newland & Bettencourt, 2020).

6. The Effects of Art Therapy on Nurses' Mental Health

Art therapies encourage participants to identify the physical, psychological, and emotional effects of workplace trauma. Specifically designed workshops aim to help individuals make sense of traumatic experiences, strengthen social support systems, and develop coping mechanisms that reduce isolation (Reed et al., 2020).

The use of art therapy in reducing mental health problems of nurses is getting more widespread. It has been reported that painting therapy facilitates the expression of emotions in a safe environment, thereby reducing stress, alleviating anxiety, and improving nurses' mental health(Kai et al., 2020). It has been found that music therapy is effective in coping with burnout, anxiety, and depress sive moods, improving psychological states, and enhancing overall physical and mental health (Zamanifar et al., 2020). It is stated that dance/movement therapy increases nurses' levels of compassion satisfaction and reduces levels of burnout and compassion fatigue (Yılmazer et al., 2020). It has also been reported that dance/movement therapy positively influences nurses' physical functioning, emotional integrity, and post-traumatic stress levels, thereby reducing psychological distress, burnout, and intentions to leave the profession (Calamassi et al., 2022).

Studies which have combined many forms of art therapy demonstrated benefits such as reducing depression and anxiety and developing positive coping styles among nurses (Zhang et al., 2024a). Furthermore, it is emphasized that art therapy has the potential to alleviate professional burnout (Moss et al., 2022), resilience (Torres et al.,2023), compassion fatigue (Ağaç et al., 2024), stress levels (Zhang et al., 2024a), and anxiety levels (Moss et al., 2022; Zhang et al., 2024a). Research has also indicated that art therapy has significant positive effects on traumatic stress symptoms, emotional states (Moss et al., 2022), positive coping strategies, and psychological well-being among nurses (Zhang et al., 2024a). All of these art therapy interventions contribute to both individual and organizational well-being by reducing occupational fatigue and enhancing communication and relationships.

7. Conclusion and Recommendations

The nursing profession involves severe mental health risks due to high levels of stress, emotional burden, and workplace demands. This has become a major issue which requires solutions at both the individual and systemic levels. Anxiety, depression, and burnout are prevalent among nurses, adversely affecting their professional performance and the quality of patient care. Therefore, art therapy has emerged as an effective intervention method that supports nurses' emotional well-being, reduces stress and burnout levels, enhances psychological resilience, and fosters insight through non-verbal expression. In this context, integrating art therapy into mental health programs for nurses, either individually or in group-based formats, may support the development of emotional regulation skills and contribute to creating a healthier and more sustainable work environment. Current findings indicate that art therapy is a promising approach for improving nurses' psychosocial well-being. Therefore, it is recommended that further empirical studies should be conducted to evaluate the long-term effects of art therapy, standardize intervention models, and extend its implementation in healthcare institutions.

Ethical Statement

Ethics committee approval was deemed unnecessary for this study, as open access sources were utilized; however, the study was conducted in accordance with ethical principles.

Financial Support for the Study

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Presentation Information

The findings of this study have not been presented at any conference or journal.

Conflicts of Interest

The authors declare no conflicts of interest regarding this study.

Author Contributions

The contributions of the authors are as follows: Mehtap Ağaç contributed to literature search and editing the report. Sultan Ayaz Alkaya conducted the supervision and final revision of the manuscript.

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Conflict and Conflict Management in Health Services: A Nursing Perspective

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Abstract

Conflict is described as a condition of disagreement or contention between individuals and/or groups, arising from factors such as resource allocation, communication breakdowns, and institutional procedures. In healthcare organizations, conflict is inevitable due to elements like the intense mutual responsibility among staff and the human-centered nature of service provision and reception. Depending on how they are addressed, conflicts may yield either positive or negative outcomes. Effective conflict management requires that involved parties possess an understanding of the nature of conflict. In healthcare institutions, conflicts may originate from various sources, including interdependence, competition over resources, differing objectives, divergent perceptions, conflicting interests, and personality clashes. These conflicts can be classified based on their function, origin, involved parties, and organizational location. Poorly managed conflicts can harm interpersonal relationships and disrupt business operations. Conversely, conflicts that are well-regulated have been shown to enhance organizational performance. Therefore, it is essential to thoroughly analyze conflicts, accurately identify their causes, and manage them using the most suitable approach. This study aims to contribute to the conflict management process by identifying the types of conflicts experienced by nurses in healthcare institutions, examining their underlying causes, categorizing conflict types, and evaluating the impact of conflicts on both staff and organizational functioning. The aim of this study is to provide up-to-date information on conflicts within the nursing profession.

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1. Introduction

Healthcare services operate within a dynamic and complex framework, where various disciplines collaborate in a coordinated manner (Ören & Dağcı, 2020). Within this framework, individual differences, workload pressures, communication issues, and organizational factors may lead to the emergence of conflicts (Tuncay et al., 2018). Conflict is commonly defined as a divergence of opinions, disagreements, or disputes among individuals or groups (Özlük et al., 2022). As an unavoidable aspect of organizational structures, conflict can produce positive outcomes when managed effectively, yet it may also negatively impact work efficiency and employee satisfaction if not addressed properly (Gökyer, 2022; Özlük et al., 2020). To determine the most appropriate way to resolve a conflict, it is necessary to analyse its type, source and process (Ekici, 2017).

Conflicts can be categorized in several ways. They may be classified based on the parties involved as individual, interpersonal, intragroup, or intergroup conflicts, and at the organizational level, they can be defined as horizontal, vertical, or command-structure conflicts (Canatan, 2023; Ekici, 2017). Due to the nature of the nursing profession, which necessitates constant interaction, conflicts occur with considerable frequency within this occupational group (Bou-Karroum et al., 2020). Nurses may encounter various types of conflicts with their peers, other healthcare professionals, supervisors, and patients or their relatives (Alshehry, 2022).

Effectively managing conflicts in nursing holds significant importance for both enhancing healthcare professionals' job satisfaction and improving the quality of patient care (Bautista et al., 2019; Labrague et al., 2018; Lee & Kim, 2019). Key sources of conflict include poor communication, role uncertainty, workload disparities, and management-related issues (Temel, 2017; Yanık, 2021). When nurses are unaware that the situation they are experiencing constitutes a conflict, or feel uncertain about how to respond after recognizing it, conflicts may persist and remain unresolved (Kızılkaya, 2024). In this context, research exploring the causes, types, and management strategies of conflicts in nursing will contribute to fostering a healthier and more productive work environment (Kızılkaya, 2024; Lee & Kim, 2019).

2. Concept of Conflict

The English word conflict stems from the Latin conflīgere, meaning "to strike together," a concept denoting collision or clash, and its usage in scholarly discourse remains rooted in this original imagery (Bercovitch & Jackson, 2009). Conflict refers to a situation that emerges from the incompatibility of differences, interests, expectations, or objectives among individuals or groups (Rahim, 2023). Although conflict—an area explored across various disciplines such as management, psychology, sociology, and communication is often regarded as a negative occurrence, it can yield constructive and progressive outcomes when handled effectively (Gökyer, 2022; Özlük et al., 2020).

Conflicts may arise at the individual, group, or organizational level (Tokmak, 2020). While individual conflicts pertain to internal dilemmas and psychological tensions experienced within a person, interpersonal conflicts are triggered by the divergence in expectations, values, or goals between different individuals (Koçel, 2023). At the group level, conflict may stem from factors such as task distribution, responsibility sharing, or the allocation of resources among teams (Al Kiyumi, 2023).

Typically, the conflict process unfolds in distinct stages (Ekici, 2017). In the initial stage, differing viewpoints between parties begin to surface. Subsequently, depending on how these differences are addressed, the conflict may either escalate or be constructively resolved through appropriate management strategies (Yanık, 2021). When conflicts are left unresolved, they may give rise to adverse consequences at both the individual and organizational level, including reduced productivity, diminished motivation, increased stress, and burnout (Al-Ajarmeh, 2021; Bayır & Gültekin, 2015). Healthcare institutions are complex systems in terms of their organisational structure. As they are based on human relationships between those who receive services and those who provide them, conflicts are inevitable in healthcare institutions. Healthcare workers therefore frequently encounter conflict (Bayar & Mete, 2022).

3. Nursing and Conflict

Nursing is a fundamental pillar of healthcare services and plays a critical role in the planning, execution, and assessment of patient care (Başoğul, 2020).

Nurses engage continuously with a diverse range of individuals, including patients, their families, physicians, other healthcare professionals, and administrators. This dynamic, multi-actor working environment can occasionally give rise to various forms of conflict (Lahana et al., 2019).

Conflicts within the nursing profession may occur at the individual, interpersonal, and organizational levels (Amjad Hashim et al., 2022). Internal conflicts experienced by nurses concerning their professional roles may result from ethical dilemmas or challenges in the decision-making process (Haji Matarsat & Abdul-Mumin, 2021). Interpersonal conflicts can emerge due to communication issues with colleagues, physicians, or other healthcare workers, perceived inequities in task distribution, or differing viewpoints (Khalili & Pourreza, 2020). On an organizational scale, elements such as administrative policies, workload, shift scheduling, and insufficient resources may act as conflict triggers (Liu, 2021).

Managing conflict effectively is vital in the nursing field (Jing et al., 2020). A well-executed conflict management approach can enhance nurses' professional satisfaction, improve team collaboration, and positively influence the quality of patient care (Sivuk & Seyhan, 2021). Conversely, unresolved conflicts that persist over time may lead to adverse outcomes for both individuals and institutions, potentially disrupting healthcare delivery (Al-Ajarmeh et al., 2021; McKibben, 2017). In this regard, it is crucial for nurses to develop conflict resolution competencies, apply effective communication methods, and reinforce their problem-solving capabilities (Vatan & Çamveren, 2022).

Additionally, when managers demonstrate awareness of the conflicts nurses face, ensure equitable task distribution, and foster a supportive work atmosphere, it can contribute significantly to conflict reduction and resolution (Gürhan & Okanlı, 2017).

4. Sources of Conflicts in Nursing

The factors leading to conflicts in the nursing profession can manifest in various forms at both individual and organizational levels (Kim et al., 2017). Some fundamental causes of conflict among nurses can be summarized as follows:

4.1. Lack of Communication

Clear and effective communication is essential for maintaining team unity and ensuring high-quality patient care. However, healthcare institutions frequently encounter communication issues due to heavy workloads, time constraints, and insufficient information flow (Canatan, 2023). Miscommunications, incomplete data sharing, and vague instructions can trigger conflicts among nurses or between nurses and other healthcare professionals (Bayar & Mete, 2022).

4.2. Role and Authority Ambiguities

Despite the existence of defined task divisions among professional groups in healthcare, role and responsibility boundaries are not always clearly established (Temel, 2017). When nurses face uncertainty regarding their job scope, this can lead to authority disputes with other professionals and tensions resulting from overlapping responsibilities (Gökyer, 2022).

4.3. Personality Differences and Value Conflicts

In multidisciplinary teams, individual differences in personality traits, value systems, and professional approaches may become sources of conflict (Koçel, 2023). Disparities in work styles among nurses, divergent leadership perspectives, and mismatches between personal expectations all contribute to heightened interpersonal tensions (Bayar & Mete, 2022).

4.4. Lack of Resources

Resource limitations—both financial and human—within healthcare institutions represent a significant source of conflict (Al Kiyumi, 2023). Inadequate equipment, medication shortages, or insufficient medical supplies can hinder nurses' ability to deliver care and lead to disputes with colleagues or supervisors (Yanık, 2021).

4.5. Corporate Policies and Management Approaches

Administrative policies, decision-making structures, and leadership styles in healthcare organizations directly shape workplace dynamics (Bayar & Mete, 2022). Excluding nurses from decision-making processes, biased performance assessments, and a lack of managerial support are major organizational conflict drivers (Kim et al., 2017).

The factors that contribute to conflict in nursing form a complex interplay of individual and institutional elements (Al Kiyumi, 2023). To manage conflicts effectively, it is essential to enhance communication

skills, promote equitable task allocation, and reinforce supportive management practices (Kızılkaya, 2024).

5. Types of Conflict in Nursing

Given that the nursing profession operates within a multidisciplinary work environment, various forms of conflict may develop among different individuals and groups (Özlük et al., 2022). Nurses frequently encounter conflicts among fellow nurses, between nurses and physicians, between nurses and other healthcare professionals, as well as between nurses and patients or their families. The origin, parties involved, and consequences of these conflicts may vary (Canatan, 2023).

5.1. Conflicts by Sides

Conflicts can be categorized into four main types based on the parties involved:

5.1.1. Individual Conflict:

This type arises from indecision, value-based conflicts, or internal tension related to one's professional responsibilities (Yanık, 2021). Ethical dilemmas, career decisions, and discrepancies between personal expectations and job demands are examples of individual conflicts (Akgün Çıtak, 2022).

5.1.2. Interpersonal Conflict:

These are conflicts that occur between two or more individuals (Bayar & Mete, 2022). Common causes include communication breakdowns, personality differences, clashes of interest, or incompatible expectations (Koçel, 2023).

5.1.3. Intragroup Conflict:

This refers to disagreements among members within the same team or group (Rahim, 2023).

Issues such as task distribution, responsibility sharing, leadership disputes, and differing work styles often lead to intragroup conflicts (Akgün Çıtak, 2022).

5.1.4. Intergroup Conflict:

These conflicts emerge between different units, professional groups, or social groups within an organization. They may be triggered by competition, resource allocation, conflicting objectives, or status rivalries (Rahim, 2023).

5.1.5. Institutional Conflicts:

Institutional conflicts refer to disagreements that arise due to the structural features and management policies of healthcare institutions (Rahim, 2023). Based on their position within the organizational structure, such conflicts are classified into vertical conflict, horizontal conflict, and command-staff conflict.

5.2. Conflicts by Nature

This classification evaluates conflicts based on their impact on the organization, distinguishing them as functional or non-functional (Yanık, 2021).

5.2.1. Functional conflict:

These are conflicts that lead to positive developments within the organization. When properly analyzed and managed, they can result in beneficial changes, highlighting deficiencies in the system and contributing to organizational improvement (Koçel, 2023).

5.2.2. Non-functional conflict:

This type of conflict fails to offer any constructive outcomes. Instead, it may negatively influence work quality, productivity, and employee job satisfaction (Koçel, 2023).

5.3. Conflicts by Position within the Organization

This classification is based on the hierarchical positions of the conflicting parties within the organization.

5.3.1. Horizontal conflict:

Conflicts that occur between individuals or units at the same hierarchical level. These typically stem from issues such as task allocation, communication breakdowns, limited resources, or personality differences (Yanık, 2021).

5.3.2. Vertical conflict:

Disputes between individuals at different levels of the organizational hierarchy. These often arise due to power dynamics, decision-making authority, conflicting expectations, or authority-related problems between supervisors and subordinates (Özlük & Ark, 2022).

5.3.3. Command-staff conflict:

Conflicts that occur between managers within the chain of command and staff members who offer consulting, expertise, or support services. Such conflicts usually result from unclear authority boundaries, differing viewpoints, or ambiguous job descriptions (Durmuş, 2020).

6. The Effects of Conflict on Nursing Services

Conflict can arise not only in professional settings but also in family and social life. It is important to recognize that conflict can have both beneficial and detrimental effects on individuals and organizations (Çalık, 2021). Acknowledging the existence of conflict and pursuing appropriate resolution strategies can yield positive outcomes for both the organization and its employees (Gökyer, 2022; Özlük et al., 2020). The effects of conflicts on the institution and employees can be classified as employee satisfaction and motivation, patient safety and quality of care, cooperation and teamwork, and burnout and tendency to leave the job (Kızılkaya, 2024).

A workplace characterized by persistent tension and poorly managed conflicts can lead to a decline in employee motivation and productivity (Bayır & Gültekin, 2015). Conflicts that emerge within the work environment can hinder communication among team members. In such an atmosphere of strained communication and interaction, the quality of care delivered by nurses may deteriorate (Kim et al., 2015). However, when conflict is managed effectively, the performance of intensive care nurses improves, and so does the quality of patient care (Al-Ajarmeh, 2021).

Nurses may experience stress when dealing with conflicts involving colleagues and other healthcare professionals. This stress can elevate their intention to leave the job and lower both the quality of care and their job satisfaction (Bautista et al., 2019; Labrague et al., 2018; Lee & Kim, 2019). In healthcare institutions, unresolved conflicts contribute to burnout and emotional exhaustion among nurses (Tüfekçi, 2018).

Research shows that nurses' ability to resolve conflicts significantly influences their levels of job satisfaction, stress, and burnout. As conflict resolution skills improve, job-related stress and burnout tend to decrease, while job satisfaction increases (Kızılkaya, 2024).

7. Conflict Management in Nursing

Nurses use a variety of conflict management strategies to effectively address interpersonal and professional tensions within healthcare settings.

The most commonly adopted approaches are cooperation, compromise, accommodation, avoidance and competition. Research consistently shows that cooperation, characterised by mutual respect and joint problem-solving, is the preferred approach for building constructive relationships and improving team dynamics (Kılıç & Duygulu, 2024). Another widely used strategy is accommodation, which balances assertiveness and cooperation, and is particularly effective in high-pressure clinical settings (Gulo & Silitonga, 2024). While compliance can be useful for maintaining harmony, overuse can lead to the suppression of concerns (Dewi et al., 2023). Conversely, avoidance and competition are less frequently used due to their potential to escalate or prolong conflicts (Assi & Eshah, 2023). A systematic review revealed that conflict management styles are influenced by leadership roles, emotional intelligence, and organisational culture (Hussain et al., 2023). In order to adapt to various healthcare scenarios and improve job satisfaction and performance outcomes, integrative approaches combining multiple styles are becoming increasingly recommended (Labrague & McEnroe-Petitte, 2018).

8. Conclusion and Recommendations

The nursing profession is a core element of healthcare services and operates within a multidisciplinary and dynamic work environment. This context exposes nurses to various forms of conflict in areas such as patient care, team collaboration, and administrative processes (Amjad & Haşim, 2022). Although conflict is often perceived negatively, it can become a constructive process when managed using appropriate strategies (Al-Ajarmeh et al., 2021).

Conflicts in nursing arise at interpersonal, institutional, and individual levels, with causes including communication breakdowns, unclear roles, workload pressures, resource shortages, and management practices (Bayar & Mete, 2022). When these conflicts are not managed properly, they can result in stress and burnout on an individual level and negatively influence the overall quality of healthcare services (Al-Ajarmeh, 2021; Bautista et al., 2019; Kızılkaya, 2024; Lee & Kim, 2019).

In conclusion, effective conflict management in nursing not only enhances job satisfaction and motivation among professionals but also plays a vital role in improving patient care quality (Gökyer, 2022; Özlük et al., 2020). Foundational knowledge about conflict can help nurses better understand the situations they face and adopt suitable approaches to manage them (Kim et al., 2015). Increasing research aimed at expanding nurses' knowledge of conflict will support their access to such essential resources. In addition, it is believed that it would be beneficial to

provide nurses with informative training on conflicts that may arise in their workplaces and methods for resolving them.

It is recommended that conflict issues in nursing be added to in-service training.

Ethical Statement

Ethics committee approval was deemed unnecessary for this study, given that open access sources were utilized.

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Presentation Information

The findings of this study have not been presented at any conference or journal.

Conflicts of Interest

The authors declare no conflicts of interest regarding this study. Any institution or organization providing funding for this research did not have any role in the design, data collection, analysis, interpretation, or publication to influence or distort the findings.

Author Contributions

The contributions of the authors are as follows: Merve Işık contributed to literature search and editing the report. Özlem Canbolat conducted the supervision and final revision of the manuscript.

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