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Contents

Chapter 1

Family-Centered Care for Pediatric Patients

Çiğdem Müge Haylı[1]

Dilek Demir Kösem[2]

Mehmet Zeki Avcı[3]

Abstract

Family-centered care aims to preserve the bonds between the child and the family, to ensure the participation of the family in the child's care, to ensure that the child feels safe in the hospital environment, and to prevent the negative effects of hospitalization on the child and the family. It is an approach used. This approach accelerates the healing process of children and prevents hospitalization from causing stress and anxiety for both the child and the family. In addition, children of families. Participating in the treatment process prevents loss of control over children, increases their self-confidence and makes it easier for children to care for them after hospital and discharge. The purpose of this book chapter is to explain the importance of the family center on child health.

Nurses among healthcare professionals will care for the child better than the parents sick children until the 1960s with the idea They were deprived of their parents (Alsop-Shiel et.al., 2001;Darbyshire ,1993). After 1961-78, mothers support in providing care has been started (3). However, health policies change and family-centered care evidence-based for implementation there was a need for studies (Kuo ve ark., 2012).

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The child family institution, which is the basic building block of society grows up, becomes conscious and prepares for society. The child's physical, mental, physiological and as a psychologically healthy individual in upbringing and health behavior The family plays a huge role in shaping the situation. Family and family members throughout one's life relations between them are interrupted at different intensities continues without interruption. To hospital communication with family for children in bed continuity is important (Aykanat ve Gözen, 2014).

Russell et al. (2014) in their study, premature families whose babies are in intensive care. The problems they experienced were questioned and the families. They cannot provide adequate interaction with their babies, breastfeeding is discontinued, parents are separated from their babies. They are worried about their health because they are far away. They could not get enough information from their staff and they experienced difficulties in communicating was determined (Russell et.al., 2014). In this context, families to meet their needs, to best meet their expectations to provide appropriate service, to ensure that the child and his/her family healing process by reducing anxiety "family-centered care" to accelerate applications have been developed (Cooper et.al., 2007).

With family-centered care health policies programs, facility design, and patient, family, between physicians and other healthcare professionals. A healthcare that shapes daily interaction expresses his approach (American Academy of Pediatrics Committee on Hospital Care, 2003). In other words, family-centered care health decisions as a partnership approach in taking has been defined (Kuo ve ark., 2012). The purpose of family-centered care whereas; maintaining bonds between the child and the family. Ensuring the family's participation in the child's care. The child feels safe in the hospital environment to make one feel, to be hospitalized negative effects on the child and family is to prevent (Aykanat ve Gözen, 2014).

1. Family-Centered Care for Child Health Positive Aspects

Parental presence and involvement in care in the hospital social, psychological and physical health of the child as it positively affects parents' its presence reduces separation anxiety and helps the child. It also increases the feeling of confidence (Boztepe, 2009). Byers and friends with 114 preterm babies and their parents in their study, family-centered care. Preterm babies in the applied group cry less, have lower stress levels and to a lesser extent analgesic. They found that they have needs (Byers et.al., 2006). Melnyk and Feinstein's (2001) participating in the child's care in the hospital may

be seen in the child after discharge. They examined the effect of behavioral change. In their study, their parents were involved in care. After discharge from hospital in children negative behavioral changes. They found that it decreased significantly. In their study, O'Brien et al. (2015) families of babies in the neonatal unit prepared a training program and family-centered applied maintenance. Feeding babies there is an increase in speed and weight gain, and there is an increase in family found that anxiety levels decreased has.

2. Family-Centered Care from the Family Perspective Positive Apects

Children getting sick and being hospitalized It is a situation that disrupts family processes. Family members regarding the child's recovery concerns, unfamiliarity of the hospital environment, encountering scary vehicles they do not recognize, themselves in the care of the child according to the nurse. Feeling less important, the child's illness feeling guilty about other family members at home concern for members' lives, child in hospital such as the economic difficulties they experience due to being reasons may cause family members to experience stress, anxiety and may cause them to experience depression (Davidson, 2009; Çavuşoğlu, 2004).

When studies on this subject are examined, Davidson et al. (2017) suggested that family-centered care anxiety of patients and their relatives reduces the healing process of patients. Schepp (1991) with mothers who stay with their children in the hospital. In his study, mothers were asked about child care and providing information about treatment, decision making during the treatment process and mothers' involvement in the care of their children. It was determined that it reduced their anxiety.

Family-centered care practices include parents and effective communication between healthcare personnel requires it to be. Families and healthcare personnel. As communication increases, mutual trust increases the feeling develops. At the same time, family-centered through care practices, families' children regaining the feeling of loss of control in one's care. It is ensured that they win (Boztepe, 2009). Evans (1994) in the study, parents' participation in care not only for children but also for parents determined that it is useful.

Dunst et al.'s (2007) family-centered meta-analysis examining the effect of care in their studies, family-centered care which increases the sense of competence increasing parent-child satisfaction commitment and behavior in a positive way. It has an impressive maintenance model. Has been stated.

Cooper et al (2007) family-centered care and neonatal intensive care. To determine the benefits of implementation in units in their study for the purpose of family-centered care practices of families with their babies commitment and baby care improving skills and helping families. Adequate information about the baby's health status. It is also effective to have they determined.

The Role of the Nurse in Family-Centered Care

A strong and strong relationship based on the love between family and child. supportive relationship is the most important support for the child is the source. Therefore, the family's child. İnvolvement in every phase of care is necessary. From conception onwards, the child is constantly family's beliefs, values, traditions, he grows up with his attitudes and practices (Teksöz and Ocakçı, 2014). Family where one or more of its members live. Any dysfunction can negatively impact the family as a whole. will affect.

The pediatric nurse is the family's only the problem, regardless of the situation. A holistic evaluation takes into consideration the individual with he wouldn't have done it (Teksöz and Ocakçı, 2014). Therefore, family-centered ability to carry out maintenance practices for parents to care for the child in hospital. It is important to support them to participate. Additionally, the nurse encourages parents to practice care. Be ready to participate in their care while preparing should evaluate whether it is not. In this process nurse education and consultancy roles guidance and guidance to parents using must have a supportive attitude (Boztepe, 2009).

Nurse while implementing family-centered care a traumatic care applications should use. Atraumatic care, health therapeutic guidelines by staff including, children's diseases improving and sustaining their lives effects on both children and their families minimizing physical and psychological stress. The aim is to provide care. Atraumatic care in practice ; massage to reduce pain application, the child's inner. Some things, such as enabling him/her to express his/her world techniques are used. Thus, the family and the child. Problems that may occur due to hospitalization can be reduced (Teksöz, 2014; Ocakcı ve Yiğen, 2014).

To implement family-centered care regulations in health and hospital policies. It is also necessary to do. Therefore, children's health nurses, parents with their children in the hospital health and hospital services so that they can stay together active role in the formulation of policies should take it (Aykanat ve Gözen, 2011). In two different studies (Boztepe and Çavuşoğlu 2009; Kuzlu, Kalıncı and Topan 2011) family-centered their

efforts regarding the maintenance. In studies, nurses' workload is mostly. He left the care of the child to the families because of have determined. However, family-centered. The main purpose of care is to provide all care for the child not to leave the burden to the mother, but to maintaining the child relationship, the child's physical and to ensure emotional comfort (Christian, 2016).

As a result, family-centered care in pediatrics while defined as "best practice", pediatric. Its application in the environment is low. It has been proven by studies (Christian, 2016). However, Makworo et al. (2016) and Dur et al. (2007) in their study with pediatric nurses to implement family-centered care. It was determined that they were willing to undergo it. However, inadequacy of policies, hospitals unavailability, patient population, parents' ignorance and nurses' families. Patients' responsibilities when participating in care problems such as experiencing anxiety due to nurses to implement family-centered care. It creates an obstacle to the passage of (Ocakçı, 2006). For this reason, nurses family by collaborating with healthcare professionals necessary to implement centered care, active participation in studies and family nursing centered care principles. It is of great importance that they reflect on their practices. Bears.

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Chapter 2

Monkeypox Virus And The Anatomical Changes It Causes In Humans

Sevda Canbay Durmaz[1*]

Figen Koç Direk[2]

Abstract

Monkeypox virus was first identified in Denmark in 1958. It was first seen in humans in 1970 in a 9-month-old male baby in the Democratic Republic of Congo. Monkeypox virus belongs to the orthopoxvirus genus within the pox virus family. This virus is detected locally and multiplies in the area where it is found, causing inflammation. It is carried to the lymph nodes, spleen, tonsils and bone marrow through the circulation in this region. The viruses that multiply here then reach target organs such as testicles and skin. The most common clinical symptoms of monkeypox virus disease are fever, fatigue, lymphadenopathy, and widespread rash all over the body. These rashes, which can be seen all over the body, including the mouth, genital area, palms and soles of the feet, start as macular and turn into papular, vesicular and pustular forms, respectively and these rashes end up crusting. This virus affects the skin, respiratory system, urogenital system, digestive system, nervous system and eyes in different ways and causes problems.

1. Introduction:

Monkeypox virus was first identified in 1958, after a study conducted on monkeys in Denmark, where symptoms similar to smallpox were observed (1). It is a zoonotic virus with enveloped double-stranded DNA and two different subspecies from the Orthopoxvirus genus, Poksviridae family, which has a lower spread rate and mortality rate than smallpox. It was first

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seen in humans in 1970 in a 9-month-old male baby in the Democratic Republic of CongoThe disease started to be seen outside Africa for the first time in 2003. It has been learned that all of these cases involved some form of interaction with imported animals (2). Later, the disease began to be seen in different countries at different times. Specifically, between 1970 and 1986, it was seen in 10 people in Sierra Leone, Nigeria, Liberia and Ivory Coast and in 394 people in Cameroon, Central African Republic and Democratic Republic of Congo. In the epidemic that occurred in Nigeria in 2017, 200 cases were detected and there were times when the epidemic rate reached a fatality rate of 3% (3). Data for June 2024 are shown in figure 1.

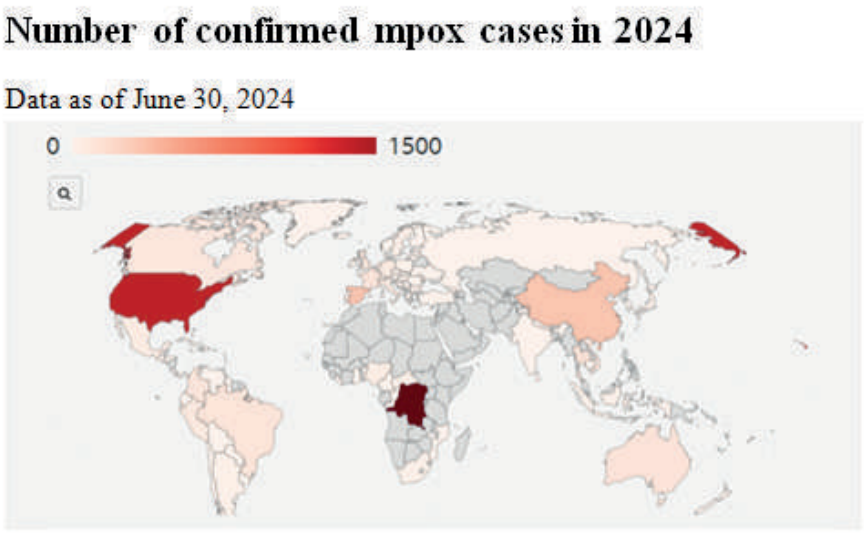

Figure 1: World Health Organization (WHO) • Confirmed case means a laboratory-confirmed, clinically compatible case. No data is available for gray countries.

More than 14,000 cases of monkeypox have been recorded in the Democratic Republic of Congo since the beginning of 2024

Africa CDC announced that there were more than 14,500 monkeypox infections and more than 450 deaths from the beginning of 2024 to the end of July.

This disease is of serious importance for global public health because monkeypox is effective not only in African countries but also in other countries of the world.

2. Pathogenesis:

Monkeypox virus belongs to the orthopoxvirus genus within the pox virus family. The Poxvirus family is divided into 2 subfamilies: Poxvirus family chordopoxvirinae and entomopovirinae. Orthopoxvirus, which includes monkey virus, is among the subgenera that infect vertebrates.

Four subgroups have been identified in the Orthopoxvirus family that are pathogenic to humans. These are vario major virus, variola minor virus, cowpox virus and MPXV, which are the causative agents of smallpox, which were eradicated in the 1980s. Two genetic divisions of MPXV have been identified: West African and Central African (5).

This virus is detected locally and multiplies in the area where it is found, causing inflammation. It is carried to the lymph nodes, spleen, tonsils and bone marrow through the circulation in this region. The viruses that multiply here then reach target organs such as testicles and skin. This period covers approximately 15 days. As a result, the clinical features of the disease become clear and the diagnosis is made (6).

3. Diagnosis:

In epidemic and infectious diseases, it is very important to diagnose them in a short time to stop the epidemic and minimize the risk. This is possible thanks to laboratory tests. (7).

Confirmation of monkeypox infection is made by nucleic acid amplification testing using real-time or conventional polymerase chain reaction (PCR) to detect virus-specific DNA sequences. Samples are taken from skin lesions. Exudate swabs, lesion surfaces and crusts are suitable places for sampling.

Virus-specific Igm can be detected in serum taken on the 5th day of the disease, and IgG positivity can be detected in serum taken on the 8th day (7).

4. Clinical features and effects on human anatomy:

The most common clinical symptoms of monkeypox virus disease are fever, fatigue, lymphadenopathy, and widespread rash all over the body. The only clinical symptom that distinguishes monkeypox virus disease from smallpox and chickenpox, which have a similar clinical course, is lymphadenopathy. The initial phase lasts approximately 2-4 days. While fever, fatigue and lymphadenopathy are the most common symptoms in the initial phase, these symptoms may also be accompanied by headache and backache (6).

Following the rise of fever, rash that begins on the face first and then occurs all over the body, resembling the rash of smallpox. Fever begins to subside 3 days after the rash appears. These rashes, which can be seen all over the body, including the mouth, genital area, palms and soles of the feet, start as macular, turn into papular, vesicular and pustular forms and end by crusting. This period in which rashes appear lasts approximately 2-4 weeks (7).

According to epidemiological studies in Africa, where it is endemic, most monkeypox infections have mild symptoms or are asymptomatic. The presence of fever, chills, weakness, muscle pain, lymphadenopathy and rash that develops especially on the face and extremities for 1-3 days in symptomatic individuals helps in the differential diagnosis of smallpox (8).

4.1. Changes in the skin:

Skin involvement in humans is the most prominent symptom of monkeypox virus disease. Classic skin rashes typically appear within 2 to 3 days after the onset of fever. Over the next 1-2 weeks, the lesions follow each other as macule, papule, vesicle and pustule. After remaining in the pustular phase for approximately 5-7 days, the lesions open, crusting and skin rashes begin. The patient usually recovers after 3-4 weeks from the first symptom, and the disease loses its infectious character, especially as the skin crusts spontaneously fall off. (9,10) (Figure 2).

Figure 2: Monkeypox skin lesions

The rash tends to affect the extremities and face rather than the trunk. Facial involvement was observed in 95% of the cases, palms and soles were observed in 75%, oral mucosa involvement was observed in 70%, genital area involvement was observed in 30%, and conjunctiva and cornea involvement was observed in 20% (11).

In a study conducted by evaluating 54 cases diagnosed with monkeypox, skin lesions were found in all cases. When the anatomical locations of these lesions are evaluated, 33 (61%) in the genital area, 31 (57%) in the penis, 3 (6%) in the scrotum, 24 (44%) in the perineal region, 27 (50%) in the hip, 11 (20%) in the arms, and legs. 11 (20%), hands 11 (20%), face 11 (20%), oropharyngeal area 4 (7%), trunk 14 (26%), genital or perianal area 51 (94%), genital and perianal area It was observed that 6 (11%) (12). In another study conducted with 197 male cases, face 71 (36%), trunk 70 (35.5%), extremities 74 (37.6%), hands and feet 56 (28.4%), genital area 111 (56%). 4%), anus and perianal region in 82 (41.6%) cases, and oropharyngeal region in 27 (13.7%) cases (13). In a study conducted with 136 cases, 39 (30%) lesions were found in the facial region, 19 (15%) in the oral region, 60 (46%) in the trunk, 33 (29%) in the anorectal region, and 24 (19%) in the vaginal region (14).

4.2. Effects on the respiratory system:

Clinical findings such as pharyngitis, oral ulcers, and tonsillitis may be observed in monkeypox. In studies conducted, sore throat and pharyngitis were 16.8%; It has been seen at a rate of 20% (13,14). Lower respiratory tract involvement is less common. However, studies have shown that some monkeys exposed to the virus developed bronchopneumonia after a period of fatal necrotization (15). It is thought that the vaccine has an effect on these findings. In a 1987 case series of 282 patients with monkeypox in the Democratic Republic of the Congo, pneumonia and pulmonary distress occurred in 11.6% of unvaccinated individuals and 3.1% of vaccinated individuals (17).

4.3. Effects on the urogenital system:

The effects of monkeypox virus on the urogenital system are common enough to require medical care. Patients complain of intense skin lesions, especially in the genital area, penile edema and other sexually transmitted diseases. Testes, ovaries and uterus can be affected by monkeypox virus. Although the degree of this effect is not clearly revealed, the possibility of sexual transmission of this virus is high (18). In a study, sexual health screening was performed in 94% of the cases and urogenital system

problems were found in all patients (12). In another study, 197 patients were evaluated and their urogenital system was evaluated. Of these, the rectum was infected in 25 (73.5%) and the urethra in 7 (20.6) cases, while Neisseria gonorrhoeae was seen in 34 (21.1%), Herpes simplex in 11 (7%) and Treponema pallidum in 6 (3.7%) cases. 56 (32.5%) of the cases had a sexually transmitted co-infection. Additionally, penile edema developed in 31 of the patients. Rectal pain or defecation pain was observed in 71 (36%) of the patients (13). Derin et al. In a case reported by , the patient was admitted to the hospital with a complaint of penile lesions and monkeypox virus was detected (19).

4.4. Effects on the digestive system:

Monkeypox virus affects the digestive system and organs and causes some clinical findings. Gastrointestinal system problems such as nausea, vomiting, diarrhea, dehydration and malnutrition are observed in patients. It has been reported that nausea and vomiting are more common, especially in pediatric patients, and less common in adults (20). Although involvement of the liver and other intra-abdominal organs is rare, its involvement can cause serious complications. Granulomatous changes and infections in the stomach, intestines and peritoneum have been observed in some studies. Some studies have shown that there may be effects on the liver and liver tissue (21).

4.5. Effects on the nervous system:

The most common neurological symptom encountered by patients with monkeypox is headache. A study showed that 24.9% of patients complained of headache (13). More serious neurological conditions may occur in the later stages of the disease. Encephalitis, meningoencephalitis and seizures are rare symptoms (22).

4.6. Eye effects:

Ocular findings in monkeypox include conjunctivitis, blepharitis, blepharoconjunctivitis, subconjunctival nodules, keratitis and corneal ulcers. Although eye pathologies are not very common, their presence is very important as it affects vision. In a study, it was determined that the rate of conjunctivitis was 20.3% and 16.4%, and keratitis and corneal ulcer were 4% (3).

5. Treatment, vaccination and prevention:

Supportive care, prevention of secondary infections and resolution of symptomatic problems are recommended in the treatment of the disease (23).

To prevent human-to-human transmission, surveillance and rapid diagnosis of new cases are critical. Close contact with infected people is the most important risk factor. Contact with skin debris and personal items of infected people should be avoided. Healthcare workers who live in the same house with the infected person and take samples from them and provide care are the group at the highest risk. Health workers, especially those taking samples, should be ensured to use personal protective equipment. It is known that the vaccine used against smallpox has 85% cross-protection. Therefore, it is recommended that healthcare workers be vaccinated against smallpox virus (24).

To prevent animal-to-human transmission, unprotected contact with wild animals, especially sick and dead animals, should be avoided. Animal meat and parts should be consumed well cooked. Contact with primates and rodents should be avoided, especially in endemic areas (25).

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Chapter 3

Air Quality and Maternal Health: Exploring the Connection to Preeclampsia

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Abstract

Preeclampsia is an obstetric disease characterized by hypertension, proteinuria, and various end-organ damages that begin after the 20th week of pregnancy. Its incidence varies between 2% and 8% of pregnancies worldwide and is responsible for 10% to 15% of maternal deaths. Despite its high incidence, the etiology of preeclampsia is still unknown. Although many maternal, placental, and fetal factors have been suggested for its etiology, it has been reported that environmental factors may also play an important role in the development of preeclampsia. Air pollution, an environmental factor, has also been considered as one of the predisposing factors for preeclampsia, and many air pollutants in the atmosphere have been associated with preeclampsia. It is thought that these air pollutants can induce systemic inflammation and oxidative stress, as well as causing vascular endothelial damage and paving the way for endothelial dysfunction that leads to the development of preeclampsia. Pregnancy represents a special and sensitive period of life for women, as it brings extensive physiological and metabolic changes, as well as changes in the cardiovascular and respiratory systems that may lead to increased susceptibility to damage from environmental factors. Pregnant women are particularly sensitive to air pollution because it disrupts the balance between Treg and Th17 cell immunity, which are particularly important for normal placental development and maintenance of pregnancy, and is involved in the pathogenesis of preeclampsia, resulting in increased

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sensitivity to pollutants. Studies on the effects of air pollution on preeclampsia are relatively recent, but increasing epidemiological evidence has shown that preeclampsia is associated with maternal exposure to air pollution during pregnancy.

Preeclampsia is a multisystemic obstetric disease defined by varying levels of placentalimalperfusion, characterized by proteinuria andihypertension that usually occur after the 20th week of gestation (Chappell, 2021). The extended effects of preeclampsia on maternal health have been extensively reported. Studies have shown a greater chance of intrauterine growth restriction and premature birth for the newborn, as well as a higher risk of diabetes, chronic renal disease, and cardiovascular disease for the mother (Mateus, 2019; Turbeville, 2020). Preeclampsia accounts for 10% to 15% of maternal mortality globally and affects between 2% and 8% of pregnancies (Duley, 2009).

Despite its high incidence, the etiology of preeclampsia remains unknown. Many maternal, placental, and fetal factors have been suggested in its etiology, but environmental elements might also have a significant part in its development. As a component of the environment, pollution in the air has been considered a predisposing factor for preeclampsia. Numerous air pollutants in the atmosphere have been linked to preeclampsia. These contaminants have the ability to cause oxidative damage and systemic inflammation, as well as cause vascular endothelial damage, which is thought to predispose to endothelial dysfunction leading to the development of preeclampsia (Gao, 2022; Shah, 2013).

A woman's life undergoes unique and delicate changes during pregnancy, including modifications to her metabolism and circulatory and respiratory systems, all of which can make her more vulnerable to environmental harm. Because air pollution upsets the balance between Th17 and Treg cell immunity, which is essential for healthy placental growth and pregnancy maintenance, pregnant women are more vulnerable to it. This imbalance is involved in the pathogenesis of preeclampsia, and high sensitivity to pollutants develops (Gao, 2022). Therefore, oxidative stress caused by particulate matter (PM) and atmospheric gases during pregnancy may alter the vascular function of the placenta, affecting the development of preeclampsia in the adverse intrauterine environment, consequently impacting fetal development and growth.

Although research on the relationship between air pollution and preeclampsia is still in its infancy, a rising body of epidemiological data has

linked preeclampsia with contact to air pollutants during pregnancy (Cao, 2021; Cao, 2020; Dadvand, 2013; Gao, 2022; Gogna, 2022; Nobles, 2015; Yang, 2019). Although the presence and density of air contaminants vary depending on the climatic and industrial environment, NO2, CO, O3, Pb, SO2, PM2.5, and PM10 are the most commonly examined pollutants (Figure 1).

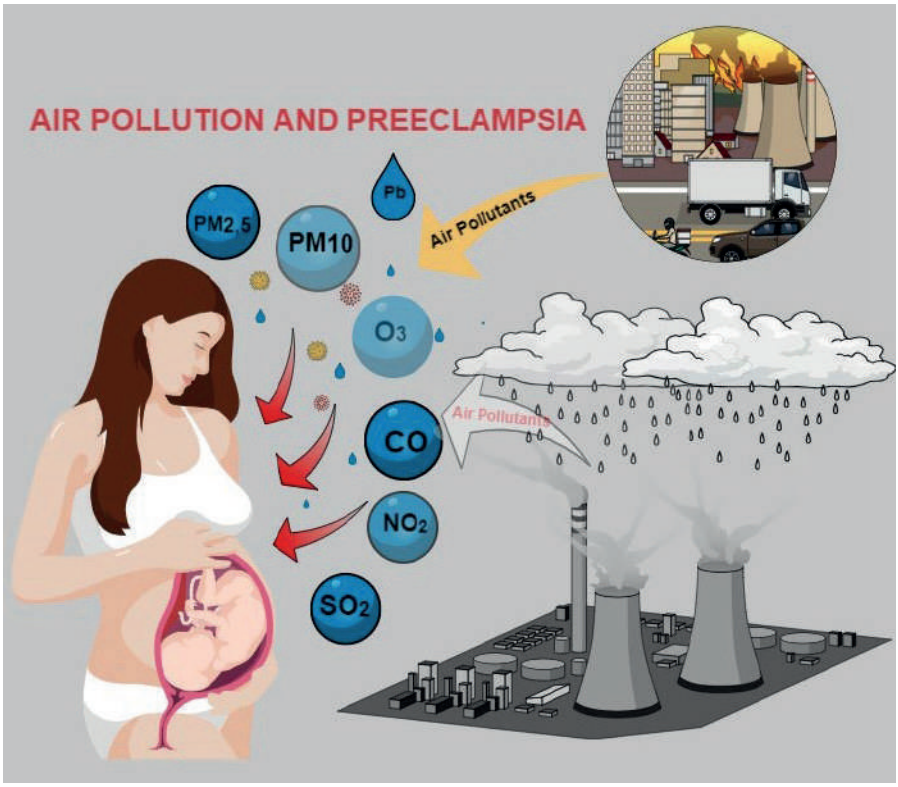

Figure 1. Air Pollution and Preeclampsia

Nitrogen Dioxide (NO2) and Preeclampsia

Nitrogen dioxide (NO2) is a reddish-brown, poisonous gas with a sharp odor similar to chlorine. It possesses strong oxidizing properties, causing significant oxidation reactions with air and water vapor, leading to the formation of corrosive nitric acid and toxic organic nitrates. This process contributes to acid rain, which can result in the death of trees, fish, and animals. Additionally, NO2 plays a key role in atmospheric reactions that lead to the formation of ground-level ozone and smog. In general, as a traffic-related pollutant, NO2 concentration is higher in cities than suburban regions.

Beyond environmental harm, NO2 poses significant health risks through inhalation. Exposure to NO2 can cause respiratory issues such as shortness of breath, inflammationxand irritation of the respiratoryxtract, and a decline in lung function. Recent studies on prenatal exposure have shown that NO2 increases the risk of preeclampsia (Goin, 2021). One study suggested that this effect might be linked to adverse impacts on trophoblast invasion and placental vascularization, as well as increases in anti-angiogenic factors like oxidative stress in addition to solublexfms-like tyrosinexkinase-1 (sFlt-1) in response to pollution in the air which is a factor in the pathophysiology of preeclampsia (Bearblock, 2021). Inxvitro and inxvivo studies on the placenta indicate that more extensive research on NO2's effects is needed.

Health Impact of Particulate Matter (PM) and Preeclampsia

Respirable PM in the atmosphere with a particle with an aerodynamic equivalentidiameter of less than 2.5 μm is called fine PM, or PM2.5. PM2.5 which is a kind of suspended particulate in the atmosphere has garnered significant attention in air pollution research due to its complex composition, which contains bacteria, viruses, water-soluble ionic salts, heavy metals, and a variety of organic contaminants (Mukherjee, 2018). PM2.5 can easily carry toxic substances into the body through respiration, potentially reaching the alveoli and bloodstream due to its tiny size, high specific surface area, and extended airborne residency duration.

Those who are exposed to air pollution have a higher risk of developing hypertension, according to several research (Honda, 2018). Preeclampsia risk has been linked to exposure to PM2.5 and PM10 (PM having a diameter of less than 10 μm) in the first trimester (Bai, 2020). The scarcity of studies regarding the relation between preeclampsia subtypes and air pollution highlights the need for up-to-date research in this field (Bearblock, 2021).

The health impact of PM increases as particle size decreases. PM with anxaerodynamic diameter of $\leq$2.5μm (PM2.5) can reach the alveoli and accumulate in the lungs, while PM10 with an aerodynamicxdiameter of $\leq$10 μm is larger and mostly accumulates in the upper bronchi. Ambient pollution in the air has been reported to rise the danger ofiihypertensive problems during pregnancy. Axmeta-analysis revealed that beeing exposed to PM2.5 and PM10 significantly increases the risks ofipreeclampsia (Pedersen, 2014).

In vitro studies have demonstrated that PM2.5 can cause trophoblasts to undergo apoptosis, reduced motility, exchange of reactive oxygen species (ROS), inflammation, and altered hormone production (Cevallos, 2017; Familari, 2019; Nääv, 2020; Qin, 2017; Wang, 2017). PM2.5, which is

approximately 1/30th the diameter of a human hair, can be transported thousands of kilometers before settling. While PM10 also contains dust from natural sources, such as volcanoes and natural fires, it is a significant source of destruction and fires caused by earthquakes. PM2.5 is mostly composed of carbon, aluminum, lead, sulfur, bacteria, and other materials (Ibrahimou, 2014).

Due to its small diameter, it is easy for PM2.5 to penetrate the respiratory barrier, enter the circulation, and enter the respiratory tract (Billet, 2007). Numerous organs and systems may experience immediate or long-term harm as a result of the complex biological reactions that PM2.5's constituents might set off. These reactions include oxidative stress, genotoxic damage, and immunological and inflammatory responses (Feng, 2016; Kreyling, 2016). Diabetes, pregnancy-related illnesses, and chronic obstructive lung disease can all arise from this. (He, 2017; Melody, 2020; Xing, 2016).

According to some research, atmospheric PM2.5 can enter the mother's circulation and pass via the placenta, oxidative stress and inflammation that can lead to placental malfunction and even preeclampsia (Brunst, 2018; Dadvand, 2013; Li, 2019; Slama, 2008). Preeclampsia risk is positively correlated with PM2.5 exposure during pregnancy, according to mounting data (Assibey-Mensah, 2020; Dadvand, 2014; Lee, 2013; Mandakh, 2020; Rudra, 2011; Wu, 2009). According to some research, there may be a higher chance of preeclampsia if pregnant women are exposed to PM2.5 during particular times (Lee, 2013; Mandakh, 2020).

Because PM2.5 has such a small particle size, there is always a risk of exposure, which has proven extremely dangerous for public health. By WHO criteria, the yearly average of 10 $\mu g/m^3$ for PM2.5 puts 92% of people globally at risk of exposure (Ghosh, 2021; Hystad, 2020). Pregnant women are particularly vulnerable to the harmful effects of PM2.5 because of the abrupt physiological shifts that pregnancy brings about (Varshavsky, 2020).

Carbon Monoxide and Preeclampsia

Carbon monoxide (CO) is an inorganic compound composed of one carbon and one oxygen atom, with the chemical formula CO. In this molecule, a triple bond exists between the carbon and oxygen atoms. CO is widely used in industry for generating various types of gases such as generator gas, water gas, power gas, and air gas, as well as serving as a fuel. CO is a odorless, colorless, and flavorless vapor that is referred to as the "silent killer." CO is mostly produced by the partial combustion of carbon-containing molecules, which can occur from a variety of biological

and environmental sources. In the industrial realm, CO plays a key role in the synthesis of several substances, such as medicines, fragrances, and fuels.

When CO concentration increases in inhaled air, it enters the bloodstream and binds more readily to hemoglobin than oxygen (O2), thereby hindering oxygen transport. CO binds to the iron atom at the center of hemoglobin, which can lead to death by asphyxiation. The relationship between CO and preeclampsia is intriguing. While harmful at high levels, recent research suggests that CO might reduce the risk of preeclampsia within certain limits. Researchers have found that CO promotes trophoblast invasion, decreases the decidual inflammatory response, increases uteroplacental blood flow, reduces hypoxia-induced apoptosis, and upregulates placental antioxidant systems. Both endogenous and exogenous CO have been reported to promote angiogenesis and suppress the release of solubleifms-like tyrosineikinase-1 (sFlt-1).

Several research have shown that CO plays a crucial role in various physiological and pathophysiological processes. Endogenous CO is a metabolite involved in the catalytic reaction and degradation of the oxygenase enzyme. CO has been shown to reduce placental apoptosis and placental perfusion pressure. Furthermore, it has been suggested that pregnant women with preeclampsia have lower tidal breath CO concentrations. Therefore, the heme oxygenase-CO pathway may be involved in the pathogenesis of preeclampsia. More research is required to investigate the potential mechanisms by which CO reduces the risk of preeclampsia (Gomez, 2020; Olgun, 2020).

Sulfur Dioxide and Preeclampsia

Sulfur dioxide (SO2) is a pungent, colorless, non-flammable, poisonous gas with the chemical formula SO2. With a gas density relative to air of 2.26, it is approximately 126% heavier than air, meaning that in case of leakage, it may accumulate near the ground and spread horizontally. The main sources of SO2 are thermal power plants and industrial boilers, with the highest concentrations found near major industrial sources.

SO2 causes the airways to narrow, impairing the lungs' defense mechanisms and potentially leading to heart diseases. Under the influence of certain chemicals and sunlight, SO2 transforms into acid rain, making it a leading pollutant in urban areas. Acid rain, smog, and reduced visibility are all consequences of high SO2 levels. Intense accumulation of SO2 can cause serious damage from both poisoning and acid rain, necessitating the

constant installation of gas detection systems in areas where SO2 gas is likely to accumulate.

It has been established that SO2 is a toxin that may raise the possibility of negative pregnancy results, including miscarriage, stillbirth, and preterm birth, during all three trimesters. Maternal exposure to SO2 has also been linked to an increased danger of preeclampsia (Raez-Villanueva, 2019; Shen, 2019; Wang et, 2018b; Zhang, 2018). Although current epidemiological studies have proven the harm of SO2 exposure to pregnant women, the mechanisms underlying these processes are still being worked out.

Environmental pollutants, including SO2, cause trophoblast dysfunction in pregnant women. Oxidative damage, characterized by high levels of ROS or other indicators of oxidative stress and decreased levels of antioxidative enzymes, is a major cause of this dysfunction (Raez-Villanueva, 2019; Shen, 2019; Wang, 2018b; Zhang, 2018).

Few research have looked at how SO2 exposure affects trophoblasts. According to one research, breathing in SO2 breaks down into its derivatives, bisulfite and sulfite, in a 1:3 M/M ratio. This can have an impact on pregnant women's placental trophoblasts (Wang, 2014). Another study used the first-trimester trophoblast cell line Swan. 71 to examine if SO2 compounds may cause trophoblast malfunction and their internal processes. According to reports, SO2 compounds cause cell apoptosis, severely lower cellular viability, stop the cell cycle in the S/G2/M phase, and impede trophoblast motility. The lowering of ROS/IL-6/STAT3 levels by SO2 derivatives is thought to be the cause of these effects (Lihao Hu, 2021). Understanding the impact of SO2 and its compounds on reproductive toxicology depends critically on these discoveries.

Ozone Gas and Preeclampsia

Ozone (O3) is a colorless gas composed of three oxygen atoms. It exists primarily in the upper layers of the atmosphere, where it is an allotrope of oxygen, also known as trioxygen. Under normal conditions, the concentration of O3 in the lower atmosphere is approximately 0.04 ppm. However, this concentration increases significantly in areas with smog. Ozone is responsible for the blue color of the sky and has a vital part in shielding Earth from the Sun's damaging ultraviolet (UV) radiation. It is formed by UV rays in the upper atmosphere and by the electric current generated by lightning in the lower atmosphere, where it helps cleanse the air. Ozone is also used as a disinfectant in the health and food sectors (Yang, 2019).

Due to chronic climate change, the ozone gas exposure limit determined by the World Health Organization (WHO) exceeds 100 μg/m3 (for eight hours of continuous exposure), raising concerns about its health risks. Ozone pollution has become a significant threat to human health, with high O3 levels and increasing anthropogenic O3 precursor emissions in recent years. In 2017, ozone pollution in China surpassed PM2.5 (44.5%), reaching 50.4% for the first time, making O3 the primary pollutant.

A growing body of literature links O3 exposure during pregnancy to an increased risk of hypertension. According to a Florida cohort research with 655,529 people, being exposed to O3 might lead to an increased danger of hypertensive disorders of pregnancy (HDP). However, studies present mixed results; a US study reported no association between early pregnancy O3 exposure and increased danger of preeclampsia or gestationalxhypertension, while Even first-trimester O3 exposure was linked to an elevated risk of preeclampsia, according to a Swedish cohort research. These discrepancies could be due to differences in O3 pollution levels across various countries and regions.

Being exposed to O3 has been specifically linked to a higher risk of gestational hypertension in individuals between the ages of 26 and 34, and preeclampsia in individuals aged 35 and older. Some studies have shown that O3 exposure in pregnant individuals aged 35 and older increases the risk of preeclampsia by 30%. This increased risk can be explained by the greater sensitivity to air pollution in advanced maternal age. Similarly, toxicokinetics, the way the body processes and eliminates toxic substances, may also vary with age. Young mothers may have a better capacity to detoxify and eliminate toxic compounds from the body (Ning, 2020).

The potential health impacts of ozone exposure during pregnancy highlight the need for ongoing research and monitoring, especially considering the varying levels of exposure and individual susceptibility factors.

Lead (Pb) and Reproductive Health

Lead (Pb) is a heavy metal with significant adverse effects on women's reproductive health. Pb is among the heavy metals with the highest environmental impact and potential harm. Women are at risk of unintentional exposure to Pb, particularly through cosmetic products, paints, batteries, and some cooking utensils. Exposure to lead has been linked to hypertension in several studies. Lead (Pb) can harm the brain and central nervous system, as well as interfere with the biological activity of enzymes and cause behavioral problems (Lu, 2018)

Reproductive health issues due to Pb exposure are not limited to women. Higher blood lead levels in men have been associated with low sperm count and poor sperm motility. During pregnancy, Pb exposure has been linked to preeclampsia, although the exact mechanisms remain unclear due to inconsistent results. Several theories have been proposed to explain the possible mechanisms:

Mobilization of Maternal Bone Lead: Maternal blood lead levels (BLL) are elevated due to the mobilization of bone lead by pregnancy-related physiological changes. The pathophysiology of preeclampsia is largely dependent on the discharge of endothelin, a vasoconstrictor implicated in inflammation, which is increased by this process.

Impact on Plasma Adrenaline and Noradrenaline Levels: An experimental animal study found that continuous consumption of drinkingİwater tainted with lead can cause a significant increase in adrenaline and noradrenaline plasma levels. This increase in bloodihypertension, partially accountable for of the preeclampsia pathogenesis, can be induced by high Pb exposure.

Changes in miRNA Profiles: Elevated maternal BLL may cause localized modifications to miRNAiprofiles. Since Pb can pass over the placenta freely, lead exposure while pregnant increases intrauterine Pb levels. High lead levels in umbilical cord blood cause changes in fetal miRNA profiles, resulting in a bgger risk of preeclampsia and undesired fetal results such as premature birth or stillbirth.

Given these potential mechanisms, it is crucial to understand the risks associated with Pb exposure during pregnancy. Continued research is needed to fully elucidate the pathways through which Pb affects maternal and fetal health, particularly concerning preeclampsia.

Sources of Lead Exposure and Health Implications

Lead exposure can occur through various environmental and occupational sources. In many regions, lead-based paints and plumbing are significant contributors to Pb exposure. Additionally, certain industrial activities, such as battery manufacturing and recycling, can lead to elevated Pb levels in the environment. Cosmetic products, particularly those imported from countries with less stringent regulations, may also contain lead.

The health implications of lead exposure are far-reaching. Chronic Pb exposure can lead to cognitive deficits, learning disabilities, and behavioral problems in children. In adults, Pb exposure has been linked to cardiovascular

diseases, kidney dysfunction, and reproductive issues. Pregnant women are particularly vulnerable, as Pb can cross the placenta and affect fetal development (Lu, 2018).

Preventive Measures and Recommendations

Preventing lead exposure requires a multifaceted approach. Key measures include:

Regulatory Enforcement: Strengthening regulations on lead content in consumer products, including cosmetics, paints, and cooking utensils, is essential.

Public Awareness: Educating the public about the sources and risks of lead exposure can help reduce unintentional exposure.

Occupational Safety: Implementing strict safety protocols in industries that use lead can protect workers from exposure.

Environmental Cleanup: Identifying and remediating lead-contaminated sites can reduce environmental Pb levels.

For pregnant women, regular screening for blood lead levels, particularly in high-risk areas, can help identify and manage exposure early. Healthcare providers should recognize the possible hazards of lead exposure at pregnancy and provide appropriate guidance and interventions.

Lead is a pervasive environmental toxin with significant implications for reproductive health. While the exact mechanisms by which Pb contributes to conditions such as preeclampsia are still being investigated, the evidence suggests multiple pathways of harm. Addressing lead exposure through regulatory measures, public education, and targeted interventions is crucial to protect maternal and fetal health. Further research is essential to fully understand the impact of Pb and to develop effective strategies for prevention and treatment.

Mechanisms of Air Pollution and Hypertension

Air pollution primarily affects hypertension through three mechanisms (Van den Eeden, 2018):

Interaction with the Sympathetic Nervous System: Through their interaction with the sympathetic nervous system, pollutants raise blood pressure by sending signals that control vascular tension and blood volume.

Oxidative Stress: Pollutants produce markers of oxidative stress in the circulation, influencing hemodynamic processes and endothelial cells to change blood pressure.

Vasoconstriction Dysfunction: Blood pressure is directly impacted by vasoconstriction dysfunction, which is brought on by pollutants.

Pregnancy is a time frame when females are particularly sensitive to toxic pollutants in the air. Exposure to pollutants at this period may be very important for the development of preeclampsia (Shih, 2017).

Air Pollutants and Preeclampsia

Because air pollutants can cause vascular endothelial damage, oxidative stress, and systemic inflammation, they have been linked to preeclampsia (Mozaffarian, 2015). Since hypertension is easily diagnosed and treated, and successful treatment is associated with reduced morbidity and mortality (James, 2014), controlling hypertension-related diseases such as preeclampsia is a cornerstone of preventive cardiovascular care. Environmental risk factors like air pollution are increasingly recognized as important determinants of preeclampsia risk.

Air pollution is also a significant risk element for adverse cardiovascular health outcomes (Brook, 2010). Evidence from animal studies (Sun, 2009) and epidemiological studies indicates that air pollution can impair cardiovascular function by causing chronic systemic inflammation and increasing oxidative stress. These effects may lead to endothelial dysfunction, changes in arterial diameter, or alterations in vascular tone and heart rate, all of which can result in increased blood pressure and hypertension/ preeclampsia (Kramer, 2010).

Preeclampsia and Long-term Health Risks

Preeclampsia is not only an obstetric problem but also poses a risk for the mother to develop many complications after pregnancy. Women who have had preeclampsia face an bigger hazard of cardiovascular problems afterwards (Irgens, 2001; Mongraw-Chaffin, 2010; Ahmed, 2014; Kestenbaum, 2003). A meta-analysis of 43 studies found an increased risk of cerebrovascular disease, stroke, hypertension, and preeclampsia with exposure to air pollution (Brown, 2013). Additionally, women with preeclampsia may have an increased danger of hypothyroidism, thromboembolism, kidney disease, diabetes, and amnesia in the long term (Williams, 2011). Preeclamptic pregnancies also pose risks to the fetus, including preterm birth, neonatal thrombocytopenia, and restricted fetal angiogenesis (Backest, 2011).

Environmental and Genetic Interactions

Improving clinical definitions of preeclampsia involves understanding the connections between the placenta and the mother's genetic and environmental variables (Valenzuela, 2012; Williams, 2011). Common environmental pollutants have received little attention. Environmental pollutants can affect trophoblasts that help form the placenta. The initial step of preeclampsia development, inadequate placentation, may be caused by inhibition or adverse effects on trophoblast migration (Goldman-Wohl, 2002). Exposure to specific environmental pollutants may have a deleterious effect on trophoblasts which leads to the genesis of preeclampsia, according to both research on animals and in vitro findings (Bechi, 2013; Fowler, 2012).

Air Pollution and Pregnancy Complications

Air pollution is a major environmental health problem, particularly for pregnant women. The World Health Organizationestimates that exposure to PM2.5 reduces life expectancy by 8.6 months in Europe. Epidemiological studies have shown that ambient air pollution, including PM2.5, PM10, CO, NO2, Pb, O3, and SO2, is linked to pregnancy complications including preeclampsia, gestationalxdiabetes mellitus, HDP, and gestational hypertension (Abdo, 2019; Mendola, 2016; Nobles, 2019; Savitz, 2015). A meta-analysis covering 10 articles showed that NO2increases the risk of preeclampsia throughout pregnancy, while CO and O3 increase the risk in the first trimester (Pedersen, 2014).

Challenges and Future Directions

Despite increased awareness of the preeclampsia hazards, clinicians face challenges due to the lack of effective treatments once diagnosed. Conventional antihypertensives are relatively ineffective in most cases, and disease management focuses on prolonging pregnancy with restrictive bed rest and anticonvulsants. Delivery of the baby and placenta is the only complete cure. Identifying new treatments for preeclampsia is crucial. Recent advances in understanding the mechanisms involved in preeclampsia development have proposed various new therapeutic approaches. Sustainable air pollution control is essential to reduce the disease burden of preeclampsia.

Conclusion

Air pollution poses significant risks to maternal and fetal health, particularly concerning preeclampsia. The mechanisms through which pollutants affect blood pressure and contribute to preeclampsia involve interactions with the sympathetic nervous system, oxidative stress, and vasoconstriction dysfunction. While hypertension-related diseases like preeclampsia are treatable, prevention through controlling environmental risk factors is paramount. Continued research and sustainable air pollution control measures are vital to improving maternal and fetal health outcomes and reducing the burden of preeclampsia.

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Chapter 4

Balance and Rehabilitation in Elderly Cancer Patients: A Review

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Abstract

In recent years, advancements in cancer diagnosis and treatment modalities have led to heightened survival rates and extended life expectancy post-cancer treatment. The incidence of cancer increases with age, and during the elderly phase following cancer treatment, individuals often experience additional challenges due to the side effects of treatments, in contrast to healthy aging.

Among elderly individuals undergoing cancer treatment or those who have survived cancer, there is a troublingly elevated prevalence of falls and subsequent mortality compared to their healthy counterparts. Sensory deficits, neuropathy, neuropathy, cachexia, sarcopenia, impaired bone integrity, sleep disturbances, cognitive decline, increased fatigue, dementia, depression and decreased physical activity due to cancer treatment increase balance problems among older cancer survivors. Metastatic conditions and continued corticosteroid and hormone therapies post-cancer are also recognized as contributors to balance issues in cancer survivors.

Early implementation of goal-oriented exercise regimens during cancer treatment is essential to reduce functional deficits and restore impaired function. Assessment and rehabilitation of impaired functioning in elderly cancer survivors is essential for safe aging in the long term.

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INTRODUCTION

The International Agency for Research on Cancer (IARC), a subsidiary of the World Health Organization (WHO), released its latest estimates of the global cancer burden on 15 December 2020. The GLOBOCAN 2020 database, part of the IARC Global Cancer Observatory, is available online and provides estimates of incidence and survival rates for 36 specific cancer types in 185 countries and for all cancer types combined for 2020. In the light of these data, it was reported that the global cancer burden increased to 19.3 million new cases and 10.0 million lives lost in 2020.[1] Despite advancements in treatment, cancer remains one of the leading causes of mortality. It is known that breast cancer is the most common cancer in the world and lung cancer is the deadliest. In men, lung cancer is the most diagnosed cancer and the leading cause of cancer-related deaths. In women, breast cancer is the most diagnosed cancer and the main cause of cancer-related deaths.[3]

Medications administered to cancer patients and their compositions are continuously evolving. A study on this subject revealed that mortality rates due to cancer decreased by 2% among individuals aged 20-49, by 3% among those aged 50-64, and by 5-6% annually among patients aged 65 years and above, with the introduction of new drugs. While the rates of cancer diagnosis have increased, improved survival rates following cancer have underscored the significance of rehabilitation processes for post-cancer quality of life.[2]

The incidence of cancer increases with age, and aging post-cancer presents increased complexities. A review focusing on priority issues in older patients with cancer highlighted the importance of epidemiologic assessment of functioning and disability, as well as evaluating the impact of cancer treatment on falls, disability, participation, survival, quality of care and cost-effectiveness. This study also discussed the effects of cancer treatment on balance and summarized assessment and recovery approaches especially in elderly cancer patients.[3]

METOD

This study was prepared as a literature review by examining a lot of studies on balance-related conditions, evaluations and results during and after treatment in elderly cancer patients and cancer survivors.

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3 "Dünya Kanser İstatistikleri 2020 – Her 5 kişiden biri kanserle karşılaşıyor (World Cancer Statistics 2020 - One in 5 people face cancer)" https://www.drozdogan.com/dunya-kanser-istatistikleri-2020-her-5-kisiden-biri-kanserle-karsilasiyor/

Clinical and research implications

Balance disturbances are frequently observed in cancer patients and usually occur from the early stages of treatment. Data emphasize that balance is impaired and walking speed decreases after the first chemotherapy session.[4]

Effects of cancer treatments on balance

A related study revealed a 26% fall risk among breast cancer survivors aged over 65 and a 22% risk among prostate cancer survivors.[5] A systematic review highlighted gait and balance impairments in breast cancer survivors and suggested interventions to improve these impairments.[6] In the literature, many reasons related to the type and stage of cancer, sensory-cognitive side effects of medications and sensory-cognitive side effects of medications have been reported to cause balance problems in the elderly undergoing and surviving cancer treatment (Table 1).

In cancer patients, factors such as metastatic status, cancer type, hormone therapy, and long-term corticosteroid use increase the risk of falls and post-fall complications.[7-10] Given that falls can lead to severe consequences, including mortality, in patients undergoing cancer treatment, early diagnosis, careful monitoring and patient education are crucial.[7-11]

Neuropathy commonly develops post-chemotherapy and radiotherapy, contributing to lower functional performance in balance-related assessments.[12-15] Sensory deficits, sarcopenia, sleep disturbances, cognitive impairment, dementia, and depression post-cancer treatments increase fall risks.[16] Visual perception deficits due to hormonal treatments, and inner ear structural changes caused by certain drugs are sensory deficits that increase the risk of falls.[17, 18] Studies indicate a higher prevalence and earlier onset of sarcopenia in cancer patients compared to the general population.[11-19] Reduced muscle strength correlates with increased fall risks, while sleep disturbances are more prevalent among cancer patients than in the general population.[20] Elderly individuals undergoing cancer treatment experience sleep problems, aggravated by anxiety and cancer recurrence.[21] Non-pharmacological interventions are recommended to prevent polypharmacy in addressing pain, depression, and fatigue, which aggravated sleep disturbances.[22, 23]

The term "chemo-brain" describes cognitive impairment resulting from cancer treatments and characterized by decreased cognitive capacity, impaired executive functions, attention deficit and decreased processing speed.[24] Factors affecting cognitive decline include cancer stage, chemotherapy

drugs, age and ongoing hormone therapy, and cognitive impairment continues after treatment.[25, 26] In a related study, it was observed that elderly cancer patients with a history of falls exhibited poorer cognitive status.[27] Depression, dementia, decreased functional capacity, inadequate social support and frailty have been identified as factors that increase risk of falls in elderly cancer survivors.[28]

Table 1. Factors That Increase the Risk of Falls by Weakening Balance Functions in Cancer Treatments

Cancer-related conditions	**Side effects of drugs**	**Psychological and cognitive effects of cancer**
Type of cancer	Weakening of bone structure	Depression
Metastatic conditions	Neuropathy	Dementia
Chemotherapy	Sensory issues	Perception of reduced social support
Radiotherapy	Decreased visual acuity	Cognitive problems
Hormone therapy	Damage to structures inside the ear	Sleep problems
Long-term use of corticosteroids	Sarcopenia	
Pain, Fatigue		

Prepared by the author using the sources indicated (references 7 and 28)

Evaluation of balance function in elderly cancer

Patients' conditions such as advanced age, polypharmacy, and opioid use, which increase the risk of falls in healthy elderly individuals, may not adequately predict the risk of falls in elderly cancer survivors. It has been reported that a distinct process, separate from age-related conditions, negatively impacts balance in cancer survivors.[16]

The Comprehensive Geriatric Assessment is often used to identify general problems in older patients. This assessment involves determining the patient's functional level as well as observing other existing conditions, psychological and financial status, level of social support, medication use, nutritional status, and cognitive function. Basic complications such as pain, fatigue, osteoporosis, and lymphedema, which are commonly seen in cancer patients, can be evaluated with this method.[29] Comprehensive Geriatric Assessment is a teamwork, and physiotherapists are a part of this team.[30]

Falls may not be a primary concern for patients or oncologists, or patients may not associate such events with their cancer treatment. Therefore, inquiring about fall history is imperative for patients or cancer survivors. One study on the subject found that only 48% of individuals who experienced falls during cancer treatment reported these events to their

oncologist. Among the reported cases, one in every 20 elderly individuals had their treatment interrupted by a fall.[31]

One of the initial tests developed in 1986 for assessing fall risk was the Get Up and Walk Test (TUG). This test was later refined and renamed the Timed Up and Go Test (TTUG). These tests comprise timed tasks, with participants scored based on task completion within specified durations. Since the TUG test does not define the time lost in each task, the Extended Get Up and Go Test (ETUG) was developed over time to assess the risk of falls, especially in people with mobility problems.[32]

While balance assessment tests are evolving, standing on one leg and the TUG test remain among the most utilized methods for assessing fall risk in the literature.[31-32] Standing on one leg for less than 30 seconds has been associated with an increased fall risk.[33] In the TUG test, participants are required to walk 3 meters in under 10 seconds. A duration exceeding 14 seconds suggests the need for home adaptations, while durations over 20 seconds indicate a significant balance disorder and the necessity of assistive devices.[34] For patients with high functionality, prioritizing walking speed over the TUG test has been recommended.[35] BESTest (Balance Evaluation Systems Test) and its shortened form, mini BESTest, are among the tests recommended to assess the risk of falls.[36]

Dynamic balance should be maintained in daily life. If patients can maintain their balance while performing tasks such as looking left and right, up and down or performing simple mathematical calculations during balance tests, it indicates that their dynamic balance is good. According to a systematic review, deficits in dual-task tests correlate with an increased risk of falls.[37] These tests can also serve as exercises to enhance balance.

Balance rehabilitation in elderly cancer patients

Optimal muscle strength, adequate bone mineral density, sufficient sensory input, and adequate cerebellar activation are essential for maintaining good balance. The primary strategy in this regard is structured exercise. However, contraindications must be carefully considered, as in any therapeutic intervention. In cancer patients, exercise should be avoided in cases of thrombocytopenia ($<200,000/\mu L$), severe anemia ($Hb<6$), or fever $>38.5°C$. In the presence of leukopenia ($<40,000/\mu L$, high risk of infection), exercise can be undertaken with precautions. Exercise is relatively contraindicated in the presence of chest pain and dyspnea and may be postponed in cases of extreme fatigue or unexplained pain on a given day.

Patients with irregular resting heart rates or blood pressure irregularities should be closely.[38]

Clinical blood values of patients can guide therapists in prescribing appropriate exercise regimens. It has been recommended that patients in poorer condition be encouraged to engage in daily activities, whereas those in fair condition (Hb>8, platelet count>30,000) should undertake moderate aerobic and mild resistance exercises. Patients in better condition (Hb>10, platelet count>50,000) are directed towards progressive resistance exercises.[39]

Exercise can be concentric or eccentric. Studies suggest that eccentric training enhances muscle tissue by increasing protein synthesis and may be beneficial for cachectic patients, who often experience sarcopenia.[40] Eccentric exercises are particularly emphasized due to their low metabolic load, suitable for frail cancer patients.[41] According to a review on exercise interventions for sarcopenic and frail elderly individuals, aerobic endurance and multicomponent exercises over three months have been shown to increase muscle strength.[42]

Bone mineral density is a crucial component of balance. In a systematic review on the subject, it was found that bone mineral density does not increase but can be maintained through exercise in cancer patients.[43] Another systematic review on vibration therapy in cancer patients revealed that this method enhances lower extremity strength, increases bone mineral density, reduces the number of falls, and improves balance.[44]

Adequate sensory input is vital for sustainable balance. A study on the effects of exercise in reducing balance issues caused by chemotherapy-induced neuropathy implemented an 8-week multimodal exercise program. This program included strength exercises (utilizing a treadmill and dumbbells), balance exercises (in single leg and tandem positions), and tempo walking (at an intensity of 13-15 RPE). While nerve conduction velocities did not objectively increase after the program, subjective complaints of neuropathy decreased, balance parameters improved, and participants' quality of life enhanced.[45]

Older individuals need proprioceptive information more than younger individuals due to reduced visual input. As a result, deficits in this system affect them more. Proprioceptive training typically involves simple to difficult exercises, progressing from fixed to moving surfaces, where visual and auditory stimuli are gradually reduced, the support surface is reduced, and the floor is varied (hard and soft surfaces). In one study, regular exercise,

including proprioceptive training, three days a week was recommended to prevent falls in the elderly. It was also stated that tempo walking should be avoided for individuals with balance problems to prevent falls.[46]

Interactive-sensor-based training can enhance proprioceptive sensory mechanisms. In a study involving cancer patients over 60 years old with neuropathy, feedback was provided to patients regarding antero-posterior-lateral oscillation and lower extremity movement errors. Consequently, both balance and gait parameters improved. This system was considered safe for advanced neuropathic cases and individuals with a high fear of falling.[47]

Sole sensation is very important for sensory input, especially in older people who have balance problems and are at high risk of falls. Therefore, it is very important for individuals to feel the sole pressure. Accordingly, shoes with high collars and thin, hard soles that facilitate clear ground feel are recommended.[48]

Adequate activation of the cerebellum is pivotal for balance. Recent studies have demonstrated the cerebellum's role as a sensory-motor center, with weakening of the cerebellum having implications for both balance and cognitive-psychological functions.[49] This interaction is bidirectional, and cerebellar activation can be enhanced through bidirectional applications. Consequently, cognitive tasks can be integrated into balance exercises to improve balance efficacy. Exercises incorporating cognitive tasks, such as predicting stepping locations in advance or singing during balance exercises, are termed dual-task net-step exercises. Studies have indicated that such exercises not only improve balance and gait but also enhance cognitive skills.[50, 51]

Visual biofeedback methods can effectively aid balance rehabilitation. For patients capable of tolerating it, the Wii Balance Board can be utilized with or without activity in front of a mirror. In patients with good condition, activities such as lying on the balance board and playing with a ball can enhance balance. Patients can also be instructed in Otago exercises for home practice, which help them identify deficiencies while performing the exercises.[52]

Virtual reality therapy is increasingly utilized in physiotherapy across various fields. According to a systematic review, engaging in virtual reality sessions at least twice a week for 30 minutes each, totaling 10 sessions, improves balance. Some applications extend session durations to one hour, yielding similar benefits. Virtual reality applications have been found to enhance static and dynamic balance, postural stability, and gait parameters in

the elderly.[53] Additionally, virtual reality applications are actively employed in cancer patients undergoing chemotherapy to alleviate pain. Although their contribution to reducing chemotherapy side effects remains uncertain, they are believed to promote relaxation through distraction.[54, 55]

Postural instability and loss of balance increase the risk of falls in cancer patients, with the addition of fatigue and sleep problems further exacerbating this risk.[56] Relaxation exercises have been recommended to address these issues.[57]

CONCLUSIONS AND RECOMMENDATIONS

The aging process is associated with an increasing prevalence of balance deficits. Older individuals undergoing cancer treatment or who have survived cancer have significantly higher rates of balance problems and fall risks compared to their cancer-free counterparts. It is recommended to improve balance in cancer patients, addressing all potential losses attributed to cancer treatment, promoting functional activity from the start of treatment, and adding balance exercises to rehabilitation protocols.

Ethics Statement

As this study is a review article, ethical approval is not required. Furthermore, it does not involve any data concerning patients or healthy individuals.

Conflict of Interest

There is no conflict of interest regarding any person and/ or institution

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Chapter 5

Shoulder Injuries in Volleyball Players: Injury Mechanisms and Injury Prevention

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Abstract

Volleyball, one of the most widely followed and team-oriented sports globally, fosters both team cohesion and strategic thinking. Despite its general safety, the sport poses specific injury risks to athletes, particularly due to the repetitive nature of its overhead movements. Shoulder injuries, prevalent among volleyball players, are often attributed to actions such as repetitive spiking, serving, and blocking. These injuries are a leading cause of missed training sessions and competitive events among athletes. When factoring in the financial impact of treatment, developing effective injury prevention strategies becomes essential. Identifying both extrinsic and intrinsic risk factors associated with shoulder injuries is a primary step in prevention efforts. In addition to assessing individual risk profiles, understanding the mechanisms of shoulder injury can significantly enhance both preventive strategies and the efficacy of post-injury rehabilitation programs. Tailored interventions focusing on strength, stabilization, flexibility, and neuromuscular training are recommended for volleyball players to minimize shoulder injury risk.

Introduction

Volleyball is one of the most popular sports, estimated by the International Volleyball Federation to be played by 500 million people worldwide, and the interest in volleyball is growing day by day. Although volleyball is generally considered a safe sport, players are at risk of some types of injuries due to the basic structure and requirements of volleyball. The ball, which

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can travel up to 80 mph during the game, can cause upper extremity injuries during hitting, passing or blocking. In addition, overuse-related injuries can be observed in elite volleyball players because of repetitive overhead movements such as spikes or blocks, which can be performed up to 40,000 repetitions per year (1,2).

It is known that the shoulder region is the most frequently injured region after the ankle and knee among volleyball players. It is estimated that shoulder injuries constitute 8-20% of volleyball-related musculoskeletal injuries (3). In a study in which 16 years of injury data were analyzed in female volleyball players, it was found that shoulder injuries ranked first among the reasons for not participating in training and matches (4). In another similar study, it was reported that shoulder injuries in volleyball players caused the athlete to stay away from sports for an average of 6.2 weeks (5). When the annual financial dimension of these injuries is considered, it is seen that emergency room and hospital costs related to injuries reach 4.6 million Euros and the cost of the days the athlete stays away from sports due to injury reaches approximately 11 million Euros (6).

In this context, strategies for the prevention of injuries gain serious importance considering the reasons such as high treatment costs after injury, time away from sports and negative effects on the athlete's career plan. Therefore, it is important to identify external and internal risk factors that may cause sports injuries and to develop strategies to prevent them (7). In addition to questioning why the athlete is at risk for injury, the mechanism of injury (how the injury occurs) is a critical factor for the prevention of injuries with multifactorial nature and the success of rehabilitation. Apart from these, the use of biomechanical models, which are based on risk homeostasis, considering the properties of tissues and the responses of tissues to exertion, will play a key role in both the prevention of injuries and the planning of a successful rehabilitation program in athletes (8).

Mechanism of shoulder injuries

In volleyball, as in handball, tennis or swimming, overhead activities that require sudden power and rotation cause biomechanical adaptations and loads on the shoulder joint. When compared to other major joints, it is seen that the range of motion and flexibility properties of the shoulder joint are more than its stability. The ball-socket relationship of the shoulder joint and the kinematic variability of repetitive overhead movements can cause injuries by overcoming the intrinsic stabilization of the shoulder joint. Apart from repetitive movements, the use of incorrect technique also increases the

risk of injury in athletes. There is also a relationship between the playing positions of volleyball players and the risk of injury. More injuries occur in spiking, serving and blocking movements compared to other movements (1,9,10).

In volleyball, players perform a highly technical spiking motion that is repeated at high frequencies during training and competition to attack. For an effective spiking, the athlete is expected to have a wide range of motion. After the shoulder joint starts the movement with elevation above 90° and slight abduction during the spiking, the degree of abduction and external rotation of the shoulder joint reaches a maximum before the ball is hit. During the acceleration phase, when the hand strikes the ball, the shoulder joint goes into internal rotation and adduction very rapidly. Internal rotation and adduction of the shoulder joint are maintained until the end of the acceleration phase (2,11,12). When the force values generated during the spiking hit are examined, it is estimated that the internal rotation torque generated at the end of the acceleration phase is approximately 50 Nm. After the ball hit, an adduction torque of 115 Nm occurs in the joint. Currently, a compression force of 800-1,500 Nm acts on the glenohumeral joint (13). Another overhead movement performed repetitively in volleyball players that causes significant loads on the shoulder joint is the serve. The extreme shoulder movements and large angular velocities that occur especially in the jumping serve create a risk for shoulder pathologies by causing an increase in the forces affecting the shoulder (13-15). These techniques that volleyball players use repetitively during training and competition may cause functional, morphologic and biomechanical changes in range of motion, muscle strength, structures of the shoulder joint and scapula.

The forces generated during both the spiking and serve can cause the humeral head to shift anteriorly over the glenoid cavity, resulting in pain and shoulder instability. This may cause overactivation of the rotator cuff muscles, which contribute significantly to the dynamic stability of the humeral head, leading to overuse injuries in this muscle group. In addition, the forces that occur during hitting volleyball players may cause negative changes in the glenohumeral ligament and labrum. The anterior displacement of the humeral head may cause compression of the rotator cuff and labrum at the posterosuperior aspect of the glenohumeral joint, leading to internal impingement (16,17).

In addition, repetitive shoulder external rotation during ball hitting in volleyball players may cause contracture in the posterior joint capsule on the dominant side. This causes the humeral head to shift posterosuperior,

leading to internal rotation deficits on the dominant side in volleyball players and causing painful conditions such as impingement or labrum tear (18). In addition, scapular depression, lateralization or unstable scapula caused by repetitive overhead activities performed by volleyball players may cause impingement syndrome by decreasing the subacromial space. Asymmetric scapular positions and movements seen in these athletes are associated with shoulder injuries. Weakness or imbalance in the periscapular muscles associated with overhead activities can lead to scapular malposition, resulting in negative effects on shoulder kinematics. Delay in activation of the periscapular muscles, which have important roles in stabilization of the shoulder joint, may result in shoulder pain or injury (19).

Risk factors and prevention approaches in shoulder injuries

Repetitive, rapid and rotational shoulder movements in volleyball, as in handball, tennis and softball, create biomechanical loads on the joint and lead to shoulder injuries. These biomechanical forces acting on the shoulder joint may cause subacromial impingement, rotator cuff muscle tears, glenohumeral joint instability and bursitis in athletes (9).

Nowadays, clinicians are working on injury prevention strategies to prevent injuries and to reduce the loss of sporting time associated with injuries. The first step to be taken in determining strategies for the prevention of injuries in athletes is to determine the risk factors related to the sport. Without taking this step, strategies to be applied for the prevention of sports injuries will have a low chance of success. Risk factors for shoulder injuries in sports branches in which repetitive overhead activities such as volleyball are frequently performed are shown below (Table 1) (20).

Table 1. Risk factors for shoulder injuries in sports where repetitive overhead activities are frequently performed

• History of shoulder pain • Loss of range of motion and flexibility • Muscle weaknesses • Agonist-antagonist muscle imbalance • Scapular dyskinesia	• Increased body mass index • Gender • Age • Position errors of the athlete • Training-competition frequency

Glenohumeral internal rotation and rotator cuff strength deficits, scapular dyskinesia, increased subacromial bursa volume and the presence of shoulder pain are the main risks for shoulder injuries in athletes who perform repetitive overhead movements. Especially pre-season loss of shoulder internal rotation range of motion, decrease in the total range of

motion in the glenohumeral joint, loss of strength in the external rotator and supraspinatus muscles, short anatomical distance between the anterior humeral head and the anterior acromion and deviations in the normal scapular position increase the risk of overuse-related injuries in the shoulder joint (21-25).

In addition to the risks mentioned above, factors such as increased body mass index, older age and years of experience may also increase the risk of injury in athletes (20). Another risk factor for shoulder injuries is the position of the volleyball player. In attacking positions, volleyball players experience shoulder injuries more frequently compared to players in blocking, setter, and libero positions (25). In addition, the structural and muscular differences of the female gender put female athletes at a higher risk for shoulder injuries. Differences in glenoid height and width, and changes in the location and depth of the glenoid notch compared to the male gender increase the risk of shoulder injury. In addition, loss of shoulder stability associated with muscular factors also increases the risk of injury in female athletes (24,26). To prevent shoulder joint injuries in volleyball players, it is important to perform the following evaluations to determine the risk factors (Table 1) (14).x

Table 2. Risk factors that should be evaluated in volleyball players for injury prevention

• Inspection and palpation (to define the number and width of problematic areas) • Evaluation of scapulohumeral rhythm. • Evaluation of scapular winging. • Evaluation of infra-lateral scapular displacement/scapular abduction. • Evaluation of impingement. • Evaluation of shoulder flexion in the sagittal plane.	• Assessment of coracoid tightness/ pectoral shortening. • Assessment of glenohumeral joint range of motion. • Assessment of anterior capsular laxity. • Assessment of strength imbalances. • Internal and external isometric muscle strength assessment. • Assessment of core stability

The first step in injury prevention in volleyball players is the use of warm-up programs consisting of both conventional and volleyball-specific exercises that focus on neuromuscular control, concentric and eccentric rotator muscle strength, scapular stabilization, and trunk stability.

Cardiorespiratory exercises with gradually increasing intensity such as running, sprinting, agility and directional running, jumping or shoulder joint circulation can be used as conventional warm-up exercises in volleyball players. After the conventional exercises, the main body of the warm-up program should consist of volleyball-specific anti-injury exercises. At

this point, shoulder external rotation strengthening, core stabilization, proprioception, plyometric and push-up exercises and passing exercises can be performed in different positions (27).

Rotator cuff muscle strengthening should be a key factor in preventing shoulder injuries in volleyball players. In recent years, the importance of eccentric strength values rather than isometric and concentric strength values of this muscle group has been emphasized. Especially eccentric strengthening exercises applied to the external rotator muscles of the shoulder make a very important contribution to the deseralization of the upper extremity during serving or hitting (28). Adaptive strength losses observed in shoulder external rotator muscle strength in volleyball players may also cause strength imbalance in the rotator cuff muscles. In one study, it was emphasized that the shoulder external rotation/internal rotation isokinetic muscle strength ratio should be 66% to prevent shoulder injuries (29). In another similar study, it was emphasized that a shoulder external rotation/internal rotation isometric muscle strength ratio of 75% may reduce the risk of shoulder injury (30).

To strengthen the rotator cuff muscles in volleyball players, exercise programs that reduce subacromial contact and do not create stress on the static stabilizers of the glenohumeral joint should be applied. Exercises performed in 90° shoulder abduction and scapular plane provide biomechanical advantages in volleyball players. In addition, oscillation, rhythmic stabilization or perturbation training added to the exercises will increase the effectiveness of the strength exercises (31)

Scapular stabilization is another important point to be considered in improving the function of the shoulder joint and protecting it against injuries in volleyball players. Since abnormal scapular positions and movements are associated with shoulder joint pathologies, scapular kinematics should be optimized in volleyball players. In this context, a slight increase in favor of scapular retractor muscles is accepted, but in general, a scapular retraction/protraction isokinetic muscle ratio of "1" is required (32). A strength increases of 10% in the dominant extremity scapular muscle strength compared to the non-dominant scapular muscle strength is also suggested (33). Increasing activity in the serratus anterior and lower-middle trapezius muscles and decreasing the increased activity in the upper trapezius muscle fibers will also contribute positively to scapular kinematics. In addition, since loss of flexibility in the pectoralis minor, levator scapula, latissimus dorsi and rhomboid muscles and the posterior glenohumeral capsule may

negatively affect scapular kinematics, methods to increase the flexibility of these tissues should be applied (31).

One of the most important ways to reduce the stress on the shoulder joint caused by repetitive overhead activities requiring high performance in volleyball players is to provide coordination of the muscles around the shoulder. The harmonious functioning of these muscles is provided by proprioception. In volleyball players, proprioception contributes to muscle coordination and has a positive effect on the dynamic stabilization of the shoulder joint (34). A significant increase in proprioception sensation can be achieved by increasing muscle spindle sensitivity and joint position sensation with exercise programs applied in volleyball players. Resistance exercises for the shoulder girdle increase the functional capacity of the dynamic stabilizers of the shoulder joint and lead to improvement in proprioception (35). Closed kinetic chain exercises may also be preferred in maintaining and restoring the dynamic stability of the joint by causing co-activation in the muscles around the shoulder with aproximations in the shoulder joint (36). In addition, open kinetic chain exercises, which provide an increase in joint position sensation, may also be preferred in the development of shoulder proprioception (37).

Conclusion

In this study, the risk factors, injury mechanisms and prevention strategies associated with shoulder injuries in volleyball players were examined. Weakness or imbalances in the rotator cuff muscles, changes in scapula kinematics, and stresses on the shoulder joint during ball contact may cause shoulder injuries. In this context, individualized strengthening, stabilization, flexibility and neuromuscular training programs minimize the risk of shoulder injury. Approaches to be applied for the prevention of shoulder injuries will reduce losses related to sports participation and health expenses. It will also contribute to minimizing the physical and psychological deterioration that can be seen in athletes after injury.

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