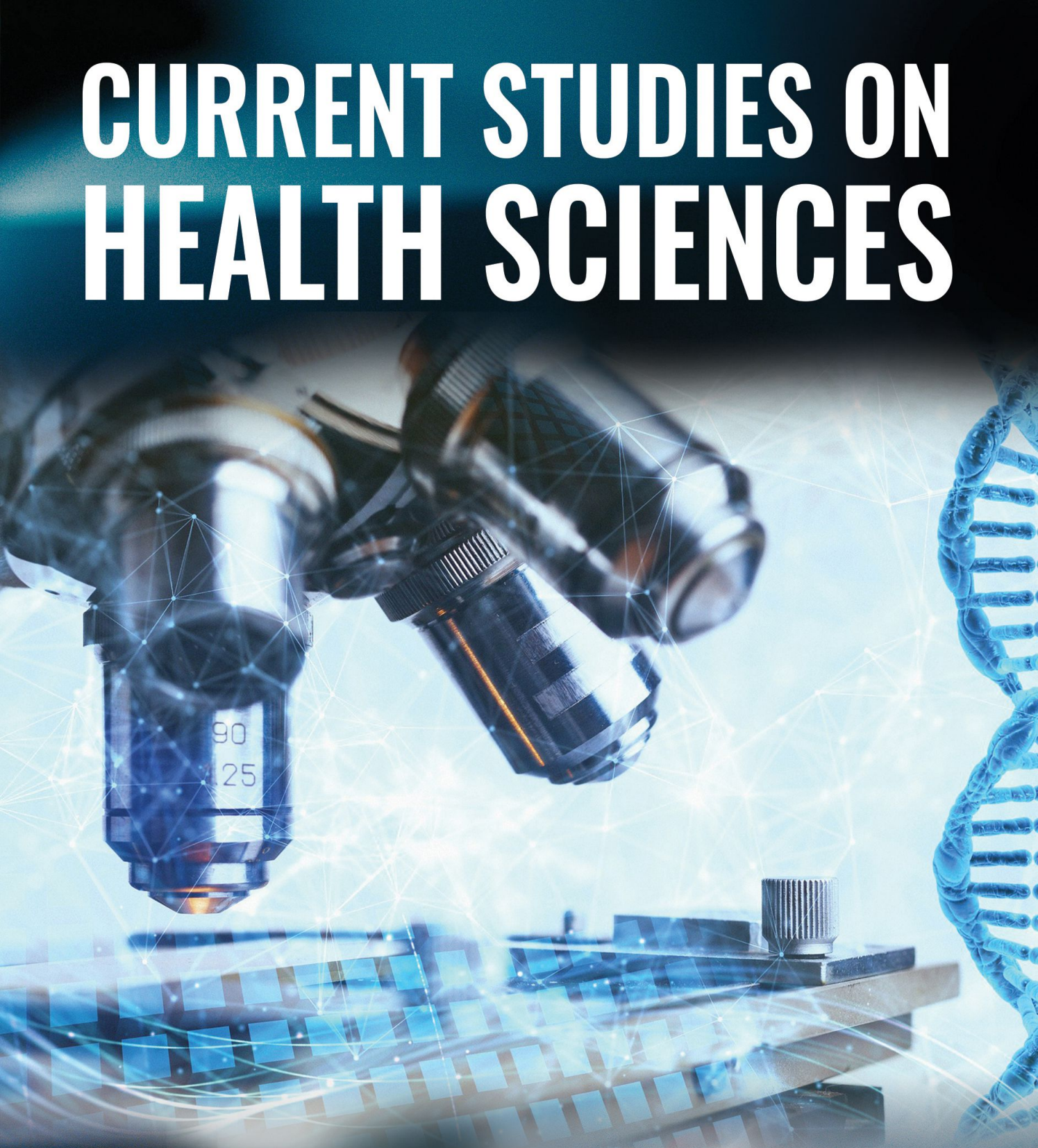
CURRENT STUDIES ON HEALTH SCIENCES



Editors
Aysel GÜVEN & Mustafa GÜLŞEN

LIVRE DE LYON
2023

Health Sciences

CURRENT STUDIES ON HEALTH SCIENCES

Editors
Aysel GÜVEN & Mustafa GÜLŞEN

LIVRE DE LYON
Lyon 2023

CURRENT STUDIES ON HEALTH SCIENCES

Editors
Aysel GÜVEN & Mustafa GÜLŞEN

LIVRE DE LYON
Lyon 2023

Current Studies on Health Sciences

Editors • Assoc.Prof.Dr. Aysel GÜVEN • Orcid: 0000-0001-7511-7105
Assoc.Prof.Dr. Mustafa GÜLŞEN • Orcid: 0000-0002-8826-8524
Cover Design • Motion Graphics
Book Layout • Motion Graphics
First Published • April 2023, Lyon

ISBN: 978-2-38236-553-3

Publisher • Livre de Lyon
Address • 37 rue marietton, 69009, Lyon France
website • http://www.livredelyon.com
e-mail • livredelyon@gmail.com

PREFACE

In the historical process, the target working areas of health services have varied depending on technology and time. These concepts, which are disease centered, patient-centered, community-centered and human-centered, have been determinative in the development and progress of health services. Innovative studies on disease and health will continue to make this field visible day by day. We hope that our book prepared for this purpose will be useful and contributing. Regards.

Assoc. Prof. Dr. Aysel GÜVEN
Assoc. Prof. Dr. Mustafa GÜLŞEN

CONTENTS

CHAPTER I

EMOTIONAL INTELLIGENCE IN HEALTH MANAGEMENT

Hüseyin Tolga ÇAĞATAY

(Asst. Prof. Dr.), Baskent University,
Vocational School of Health Services,
e-mail: tcagatay@baskent.edu.tr
ORCID: 0000-0001-5228-3223

1. Introduction

Due to its nature, health services are an area where human emotion dramas are exhibited every day and interpersonal conflicts are frequently encountered in these dramas. The intense and high sensitivity of health services requires health managers to have a high level of emotional intelligence in order to ensure a healthy communication between employees, patients and their relatives and employees. This need is very important so that health care providers and service providers can understand each other and achieve their common goals (1). Communicating with angry and impatient patients and their relatives can be effective in helping managers with high emotional intelligence better understand their different needs. Successful managers may realize that the behavior and expectations of patients and their relatives are driven by emotions rather than rational thought, and may include services provided, delay in getting work done, efficiency in handling and understanding the problem, maintaining composure even in adverse conditions, or many other criteria that can be used to reach a decision.

Despite his efforts to understand human management and various theoretical assumptions and the intricacies of human management, Daniel Goleman played an influential role in the recognition of the term "Emotional Intelligence", which is described as the key to unraveling the mysteries of the mind, in his 1996 study.

Emotional intelligence is the ability to make sense of one's own and others' emotions and take action accordingly. All of these abilities are directly linked to self-awareness and its management, as well as social awareness, which is vital in leadership roles. This study aims to summarize the results obtained from studies that emphasize the importance of emotional intelligence in health management. In this direction, together with the theoretical information covering the previous years, published between 2010 and 2022; quantitative and qualitative methodology; Studies with health administrators and specialists were taken into account.

2. Emotional intelligence (EI)

Although there are different definitions in the literature on emotional intelligence (EI), the most widely accepted is the one reported by Salovey and Mayer. This definition is expressed as "the ability to understand one's individual and others' emotions, to distinguish between them, and to use them to shape their judgments and thoughts and actions" (2,3).

It became popular as a theory after the publication of Emotional Intelligence (4). Goleman defines "EI" as the ability to motivate oneself and to recognize oneself and others on the basis of emotions in the management of emotions and relations with others (5). Emotional intelligence is conceptualized as the appropriate awareness of the emotions of individuals (6).

Bar-On treated "EI" within the framework of self, health and well-being (7). Daniel Goleman has highlighted the terms emotional intelligence and emotional quotient as an alternative to more traditional measures of intelligence (4).

The emotional intelligence model has been influenced by many scientists and researchers. Sternberg's theory of multiple intelligences proposes that interpersonal intelligence is unique and has a different nature from the mathematically-based type considered today as "IQ" or "general intelligence" (8).

It consists of the skills of understanding, perceiving and harmoniously managing one's own and others' emotions (9). It has been shown that emotional intelligence increases motivation and positive thoughts about work (10). Accordingly, the possession of emotional intelligence contributes to the fact that individuals' social aspects are considered as a managerial characteristic to be more skilled in making effective cooperation initiatives by remaining active (11).

Being emotionally intelligent means not being callous, but having the ability to distinguish between functional and dysfunctional emotions and to organize them according to the necessary situation (12).

2.1. Emotional intelligence in healthcare

The importance of considering emotional intelligence when recruiting for health care professions is becoming more and more important (13). A study conducted within the scope of private hospitals showed that there are positive relationships between emotional intelligence, empowering leadership, psychological empowerment and work engagement (14).

While it is suggested that managing emotions may be related to improving patient outcomes, a holistic approach is emphasized, which advocates the necessity of health professionals to provide physical, mental and emotional care to their patients (15, 16).

Individuals who have the intention and ability to identify and make sense of one's own and others' emotions are expected to express themselves more easily and to take care of emotional self-care. In particular, people working in healthcare services that provide care services need to show some potentially useful characteristics. Studies have shown that high emotional intelligence causes greater psychological adjustment (17) and self-compassion (18). Low emotional intelligence was found to cause more burnout (19) and stress (20, 21). The necessity of continuing to exhibit caring behavior even in highly emotional conditions in the field of health services shows the importance of emotional intelligence.

Emotional intelligence was also associated with empathy (22, 23), flexibility (24), social support (20), job satisfaction (22, 25), and caring (26, 27). In this context, the importance of emotional intelligence is clearly seen in the environments where health services are provided. It can be thought that if healthcare professionals with higher emotional intelligence are more compassionate, empathetic, flexible, loving, and able to make sense of and manage emotions in others, they will be more likely to benefit themselves and therefore their patients.

Meta-analyses combining the results of many studies show that employees who are more emotionally intelligent at work perform better (28), and tend to perform better, especially in jobs that require high emotional labor (29).

Leaders who inspire and maintain motivation in the workforce while fostering creativity and shared ownership are important to staff retention and

changing practices. "EI" has been associated with relational leadership models such as transformational leadership, which has been suggested to achieve more improved outcomes for patients (30, 31).

Empathy is another important skill that health managers should have. In its modernized form, empathy can be defined as the capacity to understand and share the emotions of others (32). Hojat defined empathy in terms of healthcare as a cognitive emotional trait that predominantly includes an understanding of the patient's pain, experiences, interests, and perspectives, combined with the ability to communicate this understanding and help (33). Emotional intelligence and empathy are closely related but have different constructs. Among the different models of emotional intelligence, the Bar-On and Goleman models accept empathy as one of its main components and suggest that there is an extremely close relationship between these two constructs (34). There is a consensus that emotional intelligence encompasses differences in people's emotional capacities, both internal (mood regulation, management of stress, and perception of their own emotions) and interpersonal (social skills, perception of others' emotions). Therefore, empathy overlaps with interpersonal emotional intelligence and improves the ability to be aware of and understand other people's emotions (35).

One of the studies that specifically evaluated the relationship between "EI" and empathy was the study conducted with 415 students who had just started medical school in Japan between 2008 and 2011. In this study, questionnaires on emotional intelligence, empathy, and personality traits were evaluated, and the results showed a weakly positive relationship between "EI" and empathy (32).

A cross-sectional study conducted with 329 nursing students from a university in Iran showed that the increase in empathy and emotional intelligence scores was directly related to the increase in empathy scores, while a strong positive relationship was found between empathy and emotional intelligence (36).

2.2. Emotional intelligence and leadership effectiveness in health management

Emotional intelligence is accepted as an important indicator for successful leadership across industries and countries (37-39). "EI" can be seen as a necessity in the management of health services due to the nature of the service provided. Nohria and Khurana point out that many researchers studying leadership focus on the "knowing" dimension of being a leader. In addition, they stated that with

"knowing", the leader emphasized his basic cognitive abilities. "Knowing" is the cognitive ability, also known as multiple intelligences, that an effective leader must possess. This ability; analytical; practice; social; It is also expressed as emotional and contextual intelligence (40). Joseph and Newman concluded that emotional intelligence positively affects performance for jobs involving high emotional labor and negatively affects performance for jobs involving low emotional labor (29). The field of health services is a field of service where emotional labor is most intense. For this reason, "EI" should be seen as a necessary feature for health managers.

A leader should be able to positively affect the performance of his organization, for which a certain working environment has been created due to his competence. Goleman is the author of many books on the application of "EI" in an organization, such as "Working with Emotional Intelligence" and "The Emotionally Intelligence Workplace". Goleman argues that the leader with a high level of "EI" is the key to organizational success and that the leader should have the ability to understand the emotions of the employees, intervene effectively in the problems, and manage their own emotions in order to gain and understand the trust of the employees (5, 41).

Reliability is another component of emotional intelligence that should be given serious consideration. Lack of emotional intelligence causes employee trust in leaders to be shaken. In the Goleman model, honesty and reliability standards, which are one of the dimensions of emotional intelligence, are preserved, while the tendency to perpetuate destructive emotions and impulses is self-management or self-regulation (4). Leaders with strong emotional intelligence bring confidence to the workplace. This encourages constructive attitudes within and between groups. It also emphasizes honesty and caring for different perspectives and opinions in decision-making processes (42).

There are studies on the importance of "EI" in important organizational issues such as leadership effectiveness and job performance (43). Studies have shown that leaders who consistently outperform their peers not only have the necessary technical skills, but more importantly, they master many aspects of emotional intelligence. In his study, Goleman states that the five components of emotional intelligence must be present in the workplace. These; They are "Self Awareness", "Self Regulation", "Motivation", "Empathy" and "Social Skills". According to Goleman, a leader's only job is to get results (5, 44).

The phenomenon of conflict is one of the main and necessary components that should be in the organizational culture of a business that aims success.

Conflict management ensures that desired results are achieved in a constructive and effective way in resolving problems (45). Responsibility for resolving and mitigating conflicts in organizations is expectedly assigned to managers because managers are assumed to have an important role in reframing an organization's positive value orientation (46). Meta-analytical results show that employees who are more emotionally intelligent tend to show superior leadership, including more constructive conflict management (47, 48). Emotional intelligence is an indicator of leader effectiveness (49-54).

While individuals with high emotional intelligence have a sense of having more power in the work environment, they can develop a perspective that their work environment is more supportive (55). It has been suggested that individuals with high "EI" have a sense of intense control over their work and therefore have better mental health (56).

Emotionally savvy leaders can use and communicate their emotions through emotional contagion mechanisms to increase their followers' levels of positive emotion and satisfaction. This reasoning style is also supported by the multilevel emotion and leadership model (57, 58).

Leaders with strong emotional intelligence find ways to further increase team effectiveness and intellectual accumulation by overcoming barriers to accessing information; they are willing to share the workload equally and seem to think about constructive discontent (59-62).

Leaders are expected to have higher emotional intelligence than other employees (52,53), and emotionally intelligent leaders take the role of "emotional managers" to set a positive "emotional tone" and create positive emotional events for and for the benefit of their subordinates (63).

Leaders can effectively manage their subordinates by making use of their emotions with emotional intelligence, thus ensuring the development of leader-subordinate relations (64).

Past research has shown that leaders with emotional intelligence are more likely or more prone to engaging in functional conflict with employees and groups, called constructive conflict management (65).

Leaders found that being positively inclined, their subordinates were more constructive and had less negative moods. This effect spreads to other members of the group simultaneously, so that leaders who adopt a positive mood instill positive emotions in their group. This spiral state plays a critical role in subordinates' belief in the sincerity of their leaders and in shaping their impressions of their leader's behavior (66, 67).

While it is claimed that emotional intelligence reveals the leadership potential, it has been revealed that the level of emotional intelligence that leaders have is related to the formation of leadership, display of effective leadership behaviors and the general effectiveness of leadership (54). These results are supported by evidence that leaders are better than others in terms of emotional intelligence (52, 53).

The presence of emotional intelligence can help especially in perceiving and understanding emotions and understanding when to empathize with subordinates who have problems. Kellett et al. found that the ability to perceive others' emotions affects empathy, relationships, and task leadership (68).

Wong and Law argued that if leaders provide psychological benefits such as approval, respect, respect and compassion to their subordinates, their satisfaction will increase, and they stated that leaders with emotional intelligence are more likely to provide such equipment to their employees. In their study, they found a positive relationship between leader emotional intelligence and subordinates' job satisfaction (69). Emotionally intelligent leaders guide their employees to exist in productive emotional states that increase their morale and job satisfaction (57).

A meta-analysis study that wanted to show the relationship between the "EI" of leaders and the job satisfaction of employees showed that this relationship exists (70, 71). Emotionally intelligent leaders are experts at displaying their emotions, creating emotion in others, and conveying authentic messages to their subordinates, thereby increasing their subordinates' job satisfaction.

Studies have found that subordinates who believe in the sincerity of their leaders will create a positive influence with enhanced effectiveness. This enhanced emotion is likely to lead to an increase in job satisfaction (66, 67).

There is increasing evidence that the spectrum of abilities that make up what is now known as emotional intelligence plays a key role in determining success in both personal life and the workplace. A study by Ruderman revealed links between certain elements of emotional intelligence and certain behaviors associated with the effectiveness and ineffectiveness of leadership (72).

3. Discussion

It is thought that this study will provide useful information for management and business practices in the health sector. Emotional intelligence and empathy play an important role in promoting patient care and engagement. Successful

emotional intelligence and empathy training improves the positive attitudes of health managers and contributes to the development of relations between employees and patients. Managers have a great influence on workplace cultures. Therefore, they need access to development programs that focus on emotional intelligence and empathy skills. A strong leadership support, systematic training programs and strategies to increase leadership competencies can be effective in helping health managers make sense of their own and their subordinates' emotions, increasing social competencies and reducing their intention to leave.

It is clear that "EI" is one of the leading players in conflict management. In particular, the ability to compromise may be necessary in acquiring constructive solutions, skills in identifying and regulating emotions. In addition, with high level of emotional intelligence, cooperative and problem-solving oriented behaviors emerge that meet the needs of both parties in conflict, control emotions to develop new solutions, and produce when necessary. On the other hand, people with low "EI" are more likely to use coercion and avoidance in conflict management (4).

Emotional intelligence has been found to be associated with workplace performance in extremely challenging work environments (73). Regarding research examining the emotional intelligence-performance link, Van Rooy and Viswesvaran conducted a meta-analytic study to examine the predictive power of "EI" in the workplace. About 5% of the variance in workplace performance was explained by emotional intelligence, concluding that this percentage is significant enough to increase savings and encourage improvements within organizations. In addition, it was concluded that more in-depth studies are needed to comprehensively understand the structure of emotional intelligence (74). Accordingly, Pérez-González and Qualter also underlined the need for emotional education (75). It is noteworthy that "EI" is positively associated with job satisfaction. In addition, emotional intelligence can affect job success because it positively affects a person's ability to cope with environmental challenges (76).

It has been suggested that emotional intelligence plays an important role in group development. Effective teamwork; It emerges when one has knowledge of the strengths and weaknesses of team members and the ability to use these strengths (77, 78). This is why it is particularly important for business leaders to display high levels of "EI" because they play a dominant role in team management and organizational development.

Studies examining the relationship between "EI" and well-being have found that emotional intelligence ability is an indicator of professional success, well-being, and socially relevant outcomes (79).

Slaski and Cartwright investigated the relationship between middle managers' "EI" and quality of work life and found that higher levels of "EI" were associated with better performance, health, and well-being (80).

Behaviors of organizational leaders can be at the forefront in shaping the emotional experiences of employees (81). One study found that leaders' emotional intelligence has a positive effect on employees' stress management, motivation, and productivity (82).

4. Conclusion

Health administrators often have difficulties in managing their work life, which is surrounded by patients and their relatives, who have excessive demands and are in a very sensitive situation, as well as health workers, because they often have high levels of stress. Therefore, having a high level of "EI" in cognitive or interpersonal skills can only help them overcome this challenge. High emotional intelligence means an increase in communication skills. This means fewer mistakes or less mistakes, while at the same time increased emotional intelligence leads to reduced stress and better stress management. Better stress management also leads to improved work-life balance, resulting in better decision making and less impulsivity. Thus, it contributes to fewer complaints from employees and patients and potentially better results.

Increased emotional intelligence also means better empathy and interpersonal skills; which inevitably leads to better patient care. Needs and concerns are communicated more easily if the health manager can build a solid bridge between healthcare professionals, patients and their relatives, and contribute to the achievement of the common goals of both parties, and can relate in a way that makes each person feel respected and understood. Thus, good communication creates reciprocity and expands the scope of care.

Understanding and changing individual behaviors is essential in the management of healthcare professionals, particularly for optimal patient care. While subject-specific education and training programs have received attention, a better understanding of individual perceptions and emotions influencing thoughts and decisions through programs focused on emotional intelligence will enhance understanding and strengthen appropriate responses by improving the

overall patient and staff experience. Healthcare organizations therefore need to recognize the contribution of personal behavior and its place in providing best practice care in addition to clinical expertise. It is important that service providers recognize the importance of responsiveness, empathy and understanding, in addition to its impact on staff and patient perceptions and relationships, and its contribution to best practice care. For healthcare administrators, having high emotional intelligence is essential for better understanding, motivation and compliance that benefits everyone involved in the delivery of healthcare.

While the evidence in some studies that the emotional intelligence of physicians and nurse leaders is associated with caring behaviors is less clear, the findings of this review should be evaluated and tentatively interpreted in light of these limitations. High-quality research is needed to further inform the evidence base and to enable future systematic reviews that focus on specific areas of emotional intelligence and pay due diligence.

References

1. Demirel, Y. (2022) İlk ve Acil Yardım Programı Öğrencilerinin Sürekli Öfke ve Öfke İfade Tarzlarının İncelenmesi, *Sağlık ve Toplum; 31*(3) 94–101

2. Meisler, G. (2014). Exploring emotional intelligence, political skill, and job satisfaction. *Employee Relations, 36*(3), 280–293. https://doi.org/10.1108/ER-02-2013-0021

3. Salovey, P., & Mayer, J. D. (1990). Emotional intelligence. *Imagination, Cognition and Personality*, *9*(3), 185–211. doi:10.2190/DUGG-P24E-52WK-6CDG

4. Goleman, D. (1995), Emotional Intelligence: Why It Can Matter More Than IQ, Bantam Dell, New York, NY.

5. Goleman, D. (1998), Working with Emotional Intelligence, Bantam Dell, New York, NY.

6. Swarnalatha, C., & Sureshkrishna, G. (2013). Emotional intelligence and job satisfaction: A study among employees of automotive industries in India. International Business Management, 7(1), 46-49.

7. Bar-On, R. (2006) "The Bar-On model of emotional-social intelligence (ESI)", Psicothema, 18(1), pp. 13–25.

8. Sternberg, R. J. (2003). A Broad View of Intelligence: The Theory of Successful Intelligence. *Consulting Psychology Journal: Practice and Research, 55*(3), 139–154. doi: 10.1037/1061-4087.55.3.139

9. Nightingale, S., Spiby, H., Sheen, K., & Slade, P. (2018). The impact of emotional intelligence in health care professionals on caring behaviour towards patients in clinical and long-term care settings: Findings from an integrative review. *International Journal of Nursing Studies*, 80, 106–117. doi:10.1016/j.ijnurstu.2018.01.006

10. Joseph, D. L., Jin, J., Newman, D. A., & O'boyle, E. H. (2015). Why does self-reported emotional intelligence predict job performance? A meta-analytic investigation of mixed EI. *Journal of Applied Psychology*, 100(2), 298–342. doi:10.1037/a0037681

11. Cole, M. L., Cox, J. D., & Stavros, J. M. (2016). Building collaboration in team through emotional intelligence: Mediation by SOAR (strengths, opportunities, aspirations, and results). Journal of Management & Organization, 25(2), 1-21. doi: 10.1017/jmo.2016.43

12. Sinha, D. (2014). Study of Emotional Intelligence Amongst the Employees of Organized Retail Sector. *International Journal of Commerce & Management, 4*(2), 1-14

13. Harper, M. G., & Jones-Schenk, J. (2012). The emotional intelligence profile of successful staff nurses. *Journal of continuing education in nursing*, *43*(8), 354–362. doi:10.3928/00220124-20120615-44

14. Alotaibi, S.M., Amin, M. And Winterton, J. (2020), "Does emotional intelligence and empowering leadership affect psychological empowerment and work engagement?", *Leadership & Organization Development Journal, 41*(8), 971-991. doi:10.1108/LODJ-07-2020-0313

15. McColl-Kennedy, J., Danaher, T., Gallan, A., Orsingher, C., Lervik-Olsen, L., & Verma, R. 18 (2017). How do you feel today? Managing patient emotions during health care 19 experiences to enhance well-being. *Journal of Business Research,* 79, 247-259. 20 doi:10.1016/j.jbusres.2017.03.022

16. Zamanzadeh, V., Valizadeh, L., Jasemi, M., Keogh, B., & Taleghani, F. (2015). Effective 19 factors in providing holistic care: A qualitative study. *Indian Journal of Palliative 20 Care*, 21(2), 214-224. doi:10.4103/0973-1075.156506

17. Ranjha, A. Y., & Shujja, S. (2010). Emotional intelligence and psychological adjustment of nurses serving in emergency and non-emergency wards. *Journal of Behavioural Sciences*, *20*(2), 36-48. 10

18. Şenyuva, E., Kaya, H., Işik, B., & Bodur, G. (2014). Relationship between self-compassion 11 and emotional intelligence in nursing students. *International Journal of Nursing Practice*, *20*(6), 588-596. doi:10.1111/ijn.12204

19. Gutierrez, D., & Mullen, P. R. (2016). Emotional intelligence and the counselor: Examining the relationship of trait emotional intelligence to counselor burnout. *Journal of Mental Health Counseling, 38*(3), 187–200. doi: 10.17744/mehc.38.3.01

20. Montes-Berges, B. and Augusto, J.M. (2007). Exploring the Relationship between Perceived Emotional Intelligence, Coping, Social Support and Mental Health in Nursing Students. *Journal of Psychiatric Mantel Health Nursing*, 14, 163-171. doi:10.1111/j.1365-2850.2007.01059.x

21. Naidoo, S. and Pau, A. (2008). Emotional Intelligence and Perceived Stress. SADJ: *Journal of the South African Dental Association*, 63, 148-151.

22. Ezzatabadi, M., Bahrami, M. A., Hadizadeh, F., Arab, M., Nasiri, S., Amiresmaili, M., & 17 Tehrani, G. A. (2012). Nurses' emotional intelligence impact on the quality of hospital 18 services. *Iranian Red Crescent Medical Journal*, 14(12), 758-763. 19 doi:10.5812/ircmj.926

23. Mayer, R. C., and Davis, J. H. (1999). The effect of the performance appraisal system on trust for management: A field quasi-experiment. *Journal of Applied Psychology*, 84, 123–136.

24. Schneider, T.R., Lyons, J.B., Khazon, S. (2013). Emotional intelligence and resilience. *Pers. Individ. Diff*. 55 (8), 909–914. doi:/10.1016/j. paid.2013.07.460

25. Lorber, M. F., Del Vecchio, T., & Slep, A. M. S. (2015). The emergence and evolution of infant externalizing behavior. *Development and Psychopathology, 27*(3), 663–680. doi:10.1017/S0954579414000923

26. Kaur, D., Sambasivan, M., & Kumar, N. (2013). Effect of spiritual intelligence, emotional 13 intelligence, psychological ownership and burnout on caring behaviour of nurses: A 14 cross-sectional study. *Journal of Clinical Nursing, 22*(21-22), 3192-3202. 15 doi:10.1111/jocn.12386

27. Rego, A., & Fernandes, C. (2005). Inteligência emocional: Contributos adicionais para a 11 validação de um instrumento de medida / Emotional intelligence: Further 12 contributions for validating a measurement instrument. *Psicologia, 19*(1-2), 139-167.

28. O'Boyle, E.H., Humphrey, R.H., Pollack, J.M., Hawver, T.H. & Story, P.A. (2011), "The relation between emotional intelligence and job performance: a meta-analysis", *Journal of Organizational Behavior*, *32*, 788-818.

29. Joseph, D.L. & Newman, D.A. (2010), "Emotional intelligence: an integrative meta-analysis and cascading model", *Journal of Applied Psychology*, *95*(1), 54-78.

30. Cummings, G. G., MacGregor, T., Davey, M., Lee, H., Wong, C. A., Lo, E., & Stafford, E. (2010). Leadership styles and outcome patterns for the nursing workforce and work 17 environment: A systematic review. *International Journal of Nursing Studies, 47*(3), 363-385.

31. Spano-Szekely, L., Quinn Griffin, M.T., Clavelle, J., & Fitzpatrick, J.J. (2016). Emotional intelligence and transformational leadership in nurse managers. *Journal of Nursing Administration*, 46(2), 101-108. doi:10.1097/NNA.0000000000000303

32. Abe K., Niwa M., Fujisaki K., & Suzuki Y. (2018). Associations between emotional intelligence, empathy and personality in Japanese medical students. *BMC Med Educ. 18*(47), 1-9. doi: 10.1186/s12909-018-1165-7

33. Hojat M. (2007).Empathy in patient care: antecedentes, development, measurement and outcome. Philadelphia: Springer; 2007.

34. Hernandez-Vargas C. I. & Dickinsion-Bannack M. E. (2014) Importancia de la inteligencia emocional em medicina. *Invest Educ Med. 3*, 155-160.

35. Austin E. J., Evans P., Magnus B. & O'Hanlon K. A. (2007). preliminary study of empathy, emotional intelligence and examination performance in MBChB students. *Medical education*. *41*(7)*,* 684-689.

36. Hajibabaee F., Farahani M. A., Ameri Z., Salehi T. & Hosseini F. (2018). The relationship between empathy and emotional intelligence among Iranian nursing students. *Int J Med Educ*. 9: 239-243.

37. Barreiro, C.A. & Treglown, L. (2020), "What makes an engaged employee? A facet-level approach to trait emotional intelligence as a predictor of employee engagement", *Personality and Individual Differences*, *159*(2), doi:10.1016/j.paid.2020.109892

38. Chen, A.S.-Y., Bian, M.-D. & Hou, Y.-H. (2015), "Impact of transformational leadership on subordinate's EI and work performance", *Personnel Review, 44*(4), 438-453.

39. Goleman, D. (2004). What makes a leader? *Harvard Business Review, 82,* 82-91.

40. Nohria, N. & Khurana, R. (2010). Handbook of Leadership Theory and Practice, Harvard Business Press, Boston, MA.

41. Goleman, D. (2001). "Emotional Intelligence: Issues in Paradigm Building", In: C. Cherniss, D.

42. Druskat, V. U., & Wolff, S. B. (2001). *Team Emotional Intelligence Assessment (TEI)* [Database record]. APA PsycTests. doi: 10.1037/t05468-000

43. Cherniss, C. (2010). "Emotional Intelligence: Toward Clarification of a Concept", *Industrial and Organizational Psychology, 3*(2), 110–126. doi:10.1111/j.1754-9434.2010.01231.x

44. Goleman, D. (2000). Leadership that gets results. *Harvard Business Review, 78*, 78-90.

45. Caudron, S. (1999). "Productive Conflict Has Value", *Workforce, February, 78*(2), 25-27.

46. Weider-Hatfield D., & Hatfield J. (1995). Relationships among conflict management styles, levels of conflict, and reactions to works, *Journal of Social Psychology*, 135, 687–98.

47. Schlaerth, A., Ensari, N., & Christian, J. (2013). A meta-analytical review of the relationship between emotional intelligence and leaders' constructive conflict management. *Group Processes & Intergroup Relations, 16*(1), 126-136. doi:10.1177/1368430212439907

48. Harms, P. D., & Credé, M. (2010). "Emotional intelligence and transformational and transactional leadership: A meta-analysis". *Journal of Leadership & Organizational Studies, 17*(1): 5-17.

49. Ashkanasy, N. M. & Daus, C. S. (2002). Emotion in the workplace: The new challenge for managers. *Academy of Management Executive, 16*, 76-86

50. Boyatzis, R., Brizz, T. & Godwin, L. (2011).The effect of religious leaders' emotional and social competencies on improving parish vibrancy. Journal of Leadership and Organizational Studies, 18, 192-206

51. George, J. M. (2000). Emotions and leadership: The role of emotional intelligence. *Human Relations, 53*, 1027-1055. doi:10.1177/0018726700538001

52. Siegling, A.B., Sfeir M., & Smyth, H. J.(2014a). Measured and self-estimated trait emotional intelligence in a UK sample of managers. *Personality and Individual Differences, 65*, 59-64

53. Siegling, A.B., Nielsen, C., & Petrides, K. V. (2014b). Trait emotional intelligence and leadership in a European multinational company. *Personality and Individual Differences, 65*, 65-68

54. Walter, F., Cole, M.S. & Humphrey, R.H. (2011), "Emotional intelligence: sine qua non of leadership or folderol?", *Academy of Management Perspectives, 25*(1), 45-59

55. Houghton, J. D., Wu, J., Godwin, J. L., Neck, C. P., & Manz, C. C. (2012). Effective stress management: A model of emotional intelligence, self-leadership, and student stress coping. *Journal of Management Education, 36*(2), 220-238.

56. Johnson, S. J., Batey, M., & Holdsworth, L. (2009). Personality and health: The mediating role of trait emotional intelligence and work locus of control. *Personality and Individual Differences, 47*(5), 470–475. doi:10.1016/j.paid.2009.04.025

57. Ashkanasy N. M. & Humphrey, R. H. (2011a). A multi-level view of leadership and emotions: Leading with emotional labor

58. Ashkanasy N. M. & Humphrey, R.H. (2011b).Current emotion research in organizational behavior. Emotion Review, 3, 214-224

59. Antonakis, J., Ashkanasy, N. M., & Dasborough, M. T. (2009). Does leadership need emotional intelligence? *The Leadership Quarterly, 20*(2), 247–261. doi:10.1016/j.leaqua.2009.01.006;

60. Brown, F. W., Bryant, S.E. & Reilly, M.D. (2006) Does Emotional Intelligence—As Measured by the EQI—Influence Transformational Leadership and/or Desirable Outcomes? *Leadership & Organization Development Journal, 27*, 330-351. doi:10.1108/01437730610677954

61. Cooper, R. K. (1997). Applying emotional intelligence in the workplace. *Training & Development, 51*, 31-38.

62. Fambrough, M. J., & Hart, R. K. (2008). Emotions in leadership development: A critique of emotional intelligence. *Advances in Developing Human Resources, 10*(5), 740-758. doi:10.1177/1523422308323542

63. Pescosolido, A. T. (2002). Emergent leaders as managers of group emotion. *The Leadership Quarterly, 13*(5), 583-599. doi:10.1016/S1048-9843(02)00145-5

64. Atwater, L. E., & Yammarino, F. J. (1992). Does self-other agreement on leadership perceptions moderate the validity of leadership and performance predictions? *Personnel Psychology, 45*(1), 141-164. doi:10.1111/j.1744-6570.1992.tb00848.x

65. Jordan, Peter J. & Troth, Ashlea C. (2004). Managing Emotions During Team Problem Solving: Emotional Intelligence and Conflict Resolution. *Human Performance, 17*(2), 195-218.

66. Dasborough, M. T., & Ashkanasy, N. M. (2002). Emotion and attribution of intentionality in leader-member relationships. *The Leadership Quarterly, 13*(5), 615-634. doi:10.1016/S1048-9843(02)00147-9

67. Groves, C.P. (2005) Order Primates. In: Wilson, D.E. & Reeder, D.M., Eds., Mammal Species of the World: A Taxonomic and Geographic Reference, 3rd Edition, Johns Hopkins University Press, Baltimore, 111-184

68. Kellett, Janet B., Ronald H. Humphrey, & Randall G. Sleeth. (2006). Empathy and the emergence of task and relations leaders. *The Leadership Quarterly*, *17*, 146-162.

69. Wong, C.-S., & Law, K. S. (2002). Wong and Law Emotional Intelligence Scale (WLEIS) [Database record]. APA PsycTests. doi:10.1037/t07398-000

70. Kafetsios, K., & Zampetakis, L. A. (2008). Emotional intelligence and job satisfaction: Testing the mediatory role of positive and negative affect at work. *Personality and Individual Differences, 44*(3), 712–722. doi:10.1016/j.paid.2007.10.004

71. Ouyang, M., & Wang, Z. (2015). Resilience Assessment of Interdependent Infrastructure Systems: With a Focus on Joint Restoration Modeling and Analysis. Reliability *Engineering & System Safety, 141*, 74-82. doi:10.1016/j.ress.2015.03.011

72. Ruderman, M.N., Hannum, K., Leslie, J.B. & Steed, J.L. (2001). Making the Connection Leadership Skills and Emotional Intelligence. *LIA, 21*(5), 3-7.

73. Schutte N. S., Malouff J. M., & Thorsteinsson E. B. (2013).Increasing emotional intelligence through training: Current status and future directions. *International Journal of Emotional Education. 5*(1), 56.

74. Van Rooy, D.L., Whitman, D.S. & Viswesvaran, C. (2010), "Emotional intelligence: additional questions still unanswered", *Industrial & Organizational Psychology, 3*(2), 149-153.

75. Pérez-González JC, & Qualter P.(2018). Emotional intelligence and emotional education in school years. In Dacree Pool L., Qualter P, editors. An Introduction to Emotional Intelligence. Chichester: Wiley; 2018. 81–104.

76. Moreno-Jimenez B., Blanco-Donoso L. M., Aguirre-Camacho A., de Rivas S., & Herrero M. (2014). Social skills for the new organizations. *Behavioral Psychology-Psicologia Conductual. 22*, 585–602.

77. Chiva R., & Alegre J. (2008), Emotional intelligence and job satisfaction: The role of organizational learning capability. *Personnel Review, 37*(5–6), 680–701.

78. Humphrey R. H., Pollack J. M., & Hawver T.(2008). Leading with emotional labor. *Journal of Managerial Psychology. 23*, 151–168.

79. Hur, Y. & Van Den Berg, P. T. & Wilderom, C. P.M. (2011). "Transformational Leadership As A Mediator Between Emotional Intelligence and Team Outcomes", *The Leadership Quarterly, 22*, 591–603.

80. Slaski M., & Cartwright S. (2002). Health, performance and emotional intelligence: An exploratory study of retail managers. Stress and Health: *Journal of the International Society for the Investigation of Stress. 18*(2), 63–68.

81. Kaplan S., Cortina J., Ruark G., LaPort K., & Nicolaides V. (2014). The role of organizational leaders in employee emotion management: A theoretical model. *The Leadership Quarterly*. (3), 563–580.

82. Batool B. F., (2013).Emotional intelligence and effective leadership. *Journal of Business Studies Quarterly. 4*(3), 84.

CHAPTER II

PHYSIOTHERAPY APPROACHES FOR UPPER EXTREMITY LYMPHEDEM AFTER LYMPHODEM AND BREAST CANCER SURGERY

Konca KAYA TATAR

Department of Therapy and Rehabilitation, Vocational School of Health Services, Baskent University, Adana, Turkey
e-mail: koncakaya@gmail.com, koncatatar@baskent.edu.tr
ORCID: 0000-0002-7991-9604

1. INTRODUCTION

Lymphedema is a chronic progressive condition in which the lymph volume exceeds its transport capacity with the accumulation of protein-rich tissue fluid in the interstitial cell spaces as a result of developmental anomaly or damage of the lymphatic system. It can be seen in various body parts such as upper and lower extremities, head and face region, cervical, chest, back, genital and abdominal regions due to the deterioration of lymphatic flow in the parts where lymph nodes and vessels are located. Early diagnosis and treatment are important to prevent or reduce complications such as disability, infection, depression, loss of sensation, pain, and malignant transformation (1,2).

1.1. Etiology

According to its origin, lymphedema was defined by Kinmonth in 1957 as primary lymphedema and secondary lymphedema. Primary lymphedema; It can also develop as a result of genetic diseases such as embryological development disorder of the lymphatic system (aplasia, hypoplasia, abnormal lymphatic vesicles, hyperplasia, lymphangiectasia), Milroy's Disease (mutation of vascular

endothelial growth factor 3). Primary lymphedema is classified into 3 groups according to the age of onset of lymphedema.

- Congenital
- Precox (1-35 years)
- Tarda (After 35 years)

Secondary lymphedema, on the other hand, occurs due to the interruption of normal lymph flow due to obstruction, fibrosis or traumatic injury of the lymphatic channels as a result of the reduction of the lymphatic system or lymphatic flow due to a subsequent condition (radiotherapy, surgery, infection, trauma, etc.). The incidence and pleverance of secondary lymphedema is higher than that of primary lymphedema (3). 3. Risk Factors in the Formation of Lymphedema Other risk factors affecting the formation of lymphedema; radiotherapy, seroma formation, type of surgery (number of removed and affected lymph nodes), amount and duration of drainage after surgery, high body mass index (BMI), advanced age, sedentary life, advanced cancer, metastasis in the axilla, and infected wounds. The main risk factors are that the affected extremity is not used or overused, trauma, local or general application of heat to the affected extremity (4).

1.2. Risk Factors in the Formation of Lymphedema

Other risk factors affecting the formation of lymphedema; radiotherapy, seroma formation, type of surgery (number of removed and affected lymph nodes), amount and duration of drainage after surgery, high body mass index (BMI), advanced age, sedentary life, advanced cancer, metastasis in the axilla, and infected wounds. The main risk factors are that the affected extremity is not used or overused, trauma, local or general application of heat to the affected extremity (1,5).

1.3. Clinical Features and Staging

In the diagnosis of lymphedema, lymphedema should be staged according to clinical findings after classification according to its etiology (6).

Table 1. Lymphedema stages

Clinical Stage	Definition
Stage 0	Lymphatic system is affected No swelling Subclinical stage
Stage 1	Partially high protein content Early period; edema accumulation phase Edema limb elevation decreases There may be pitting (gode)
Stage 2	Edema is partially reduced by extremity elevation Pitting (gode) is quite clear
Stage 3	Stage of lymphostatic elephanthiasis Excessive edema Gode does not occur in the late period Trophic changes in the skin

1.5. Diagnosis and Evaluation in Lymphedema

In the diagnosis, treatment and follow-up of lymphedema, anamnesis, inspection, palpation, volumetric and circumference measurements should be performed and evaluated in terms of differential diagnosis (7). Imaging methods are preferred for definitive diagnosis in morphological structure and suspected combined forms of lymphedema. The most common imaging method for diagnosis is radionuclide lymphoscintigraphy. Methods such as tonometry, bioelectrical impedance, magnetic resonance imaging, computed tomography, and ultrasonography are also used for diagnosis and follow-up in lymphedema (8).

History: Lymphedema history (onset time, triggering factor), medical treatment history, number of lymph nodes removed during surgery, patient symptoms should be questioned and evaluated with in the scope of history. Generally, patients with lymphedema report that they do not complain of severe pain, have a feeling of heaviness/fullness in their extremities, and feel restless in the body part where lymphedema occurs. If there is pain and/or numbness in the affected extremity, their severity and causes should be questioned.

Inspection: Skin color, brightness, skin integrity, skin folds, scar/ incision structure are observed (9).

Palpation: Skin mobility, tissue and density of edema, presence of fibrosis, muscle tone, skin temperature and tenderness, loss of sensation of the affected extremity and whether edema has pitted or not are examined. Stemmer sign, which is a physical examination method used in the diagnosis of lymphedema, is evaluated by observing the mobility of the skin from the dorsum of the 2nd metatarsophalangeal joint in the foot and the 3rd metacarpophalangeal joint in the hand. The absence of Stemmer's sign does not affect the diagnosis of lymphedema.

Volume measurements: Volumetric measurement, bioimpedance and infrared optoelectronic evaluation methods are volume measurement techniques used in the diagnosis and follow-up of lymphedema.

Volumetric measurement: A volume difference of 200 ml or more measured between the two extremities or a volume change of more than 10-20% of the affected extremity is considered lymphedema. The volumetric measurement used in the diagnosis and follow-up of lymphedema has been accepted as the gold standard because it reflects the changing lymph fluid volume during the treatment process. The patient is asked to immerse his extremity in a cylindrical container.

Figure 1: Volumetric messuring device

The volume difference between the affected and unaffected extremities is determined (10,11).

Bioimpedance: The extracellular fluid volume in the tissue is determined by measuring the bioimpedance created by the alternating current given by the electrodes placed on the affected extremity by the fluid components of the body. This measurement is more sensitive in determining the volume difference compared to the measurement volumetric measurement (12).

Infrared optoelectronic volumemetry: The optoelectronic device using infrared rays converts the results of frequently spaced circumference measurement in the edematous region into volume measurement. It has been reported in the literature that the optoelectronic method used in volume evaluation gives more reliable and objective results than the water displacement method and environmental measurement methods (13).

Circumference measurements: It is the measurement of the extremities with a circumferentially inflexible tape measure. The difference between affected and unaffected extremities is used in the diagnosis and evaluation of lymphedema.

Kuhnke's Disk Method: It is a method of measuring the circumference of the extremity, defined by Kurz, starting from the distal ulnar styloid process and measuring proximally up to the axilla at intervals of 4 centimeters (cm) (14).

Frustrum Method: It is measuring the circumference of the places where the extremity tone is the most and the least. By measuring the distance between two detected points, the volume is calculated with the formula. According to some researchers, a difference of more than 10% is significant for a positive test, while a measurement difference of more than 2 cm is considered significant by some researchers (15).

Differential Diagnosis of Lymphedema: Differential diagnosis should be made before diagnosis for lymphedema treatment success. Other complications associated with lymphedema should be evaluated. Intervening conditions such as obesity, hypertension, venous insufficiency, diabetes, cardiac and thyroid diseases, trauma or recurrent infection can become a complicated clinical picture. In unilateral limb lymphedema, the presence of visceral tumors that impede the circulation of proximal lymphatics should be considered (16).

1.6. Lymphedema Complications

Lymphedema caused by breast cancer and breast cancer treatment may lead to the development of infections such as cellulitis, lymphangitis, and

sometimes lymphangiosarcoma (Steward-Treves Syndrome). It can affect the functionality of daily living activities by causing pain, swelling, numbness in the arm, and limitation of shoulder movements (17). Lymph cysts may develop due to abnormal increase in lymphedema (18).

1.7. Lymphedema Treatment

Lymphedema is a chronic progressive disease that requires early diagnosis and treatment. Lymphedema treatment aims to reduce the symptoms, restore the functionality of the affected body area and keep the complications that may develop to a minimum. Lymphedema treatment is applied in the form of physiotherapy, pharmacological treatment, surgical treatment and other treatments (10).

2. PHYSİOTHERAPY METHODS IN LYMPHEDEMA TREATMENT

2.1. Complex Decongestive Therapy

In the report of the International Society of Lymphology published in 2001, complex decongestive therapy (CDT) was accepted as the current international standard treatment in the treatment of lymphedema (19). Complex decongestive therapy is a 4-component and two-phase treatment method used in the treatment of lymphedema (Table 2).

Phase 1: It is the intensive treatment phase, in which the patient comes to treatment every day, and the treatment duration varies according to the lymphedema stage of the patient, with an average of 3-4 weeks in the upper extremity and 4-6 weeks in the lower extremities.

Phase 2: It is aimed to protect the patient by maintaining the improvement in Phase 1 treatment. In this life-long phase, compression garments should be worn during the day and bandage should be applied at night.

Table 2. Phases of complex decongestive therapy

PHASE 1	PHASE 2
Manual lymph drainage	Self manual lymph drainage
Skin care	Skin care
Compression bandage	Compression garment/bandage
Exercise	Exercise
Self care	Self care

If the difference in the volume between the extremities in the circumference or volumetric measurement made in the weekly patient treatment follow-up is the same or less than the previous measurement, the second phase is started. This phase continues throughout life in lymphedema, but in possible cases, phase 1 can be transitioned. It has been found that CDT provides a 21% to 56% reduction in lymphedema treatment compared to classical physiotherapy modalities (20).

2.1.1. Components of Complex Decongestive Therapy

Manual lymph drainage (MLD): Manual lymph drainage, one of the four basic elements of CDT, was developed by Vodder in 1932. It is a specific drainage technique used to increase lymph flow and reabsorption without increasing ultrafiltration. Thanks to special hand techniques applied on the skin in certain directions, lymphatic drainage is increased by causing superficial lymphatic mobility (21). There are different MLD methods such as Vodder, Földi, Leduc or Casley-Smith (20). It is performed by applying a pressure of 30 to 45 mmHg to the superficial lymphatic vessels just below the skin in the lymphatic system (22). In the treatment of lymphedema after breast cancer surgery, the supraclavicular lymphatics and cisterna chyli should be stimulated in manual lymph drainage, respectively, and then the ventral and dorsal axilla-axillary, axillo-inguinal anastomoses, the proximal and then the distal part of the upper extremity should be drained. Drainage time is approximately 45-60 minutes. In the manual lymphatic drainage technique, the edema is transferred from the midline of the body to the opposite side, other functional lymphatic structures, the inguinal region, and upwards from the shoulder and then to the back. Finally, the arm region, forearm region, hand and fingers are drained, the drainage direction for the upper extremity is from proximal to distal, distal to the whole body (23, 24). (Figure 2) (25). MLD; It includes the four basic Vodder grips, which are working and resting phases, standing circles, scooping, pumping, and spinning.

Each grip is repeated 5-7 times in the same area. The working phase lasts for 1 second and lymphangiomotoricity is increased by stretching the anchoring filaments in the lymph capillaries. The pressure on the grips should not be high to avoid traumatic injury. Manual lymph drainage is a different technique from conventional massage or connective tissue massage. These massage techniques may injure lymphatic vessels located close to the skin surface. This drainage technique, which is applied with very slow, light and rhythmic movements, also provides a decrease in pain with a mechanism based on the door control theory

(26). Manual lymphatic drainage is contraindicated in cases of acute cellulitis, uncontrolled infections, arterial or cardiac edema (congestive heart failure), renal failure, and pregnancy (27).

Self Manual Lymphatic Drainage (SLD): It is a manual lymphatic drainage arranged in a way that the patient can apply by himself. During the phase 2 treatment, it is recommended to be administered by the patient or their relatives for 10-20 minutes, twice a day, in combination with breathing (28).

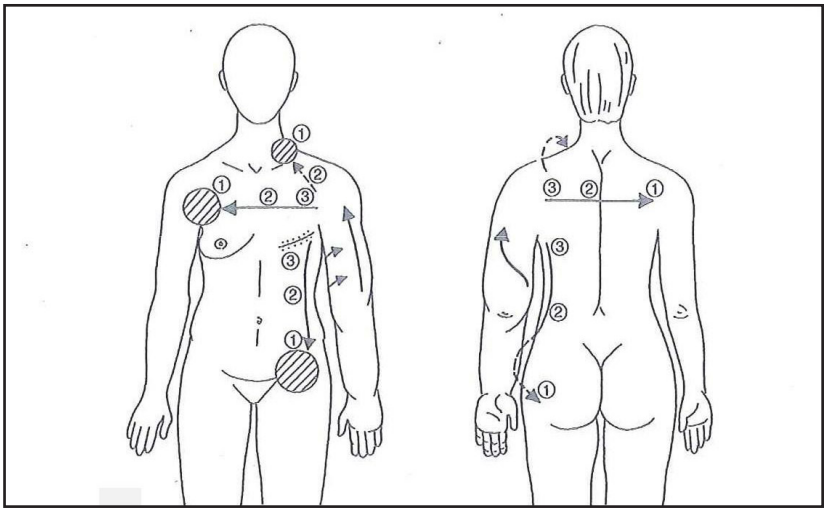


Figure 2: Upper extremity self manual drainage flow direction (25)

Compression therapy: Compression is the most important component of CDT. During phase 1 treatment, compression bandages should be applied for approximately 22-23 hours a day. The aim is to reduce the volume of the extremity by allowing the edema to reach a certain form (28). Compression bandages or compression garments are recommended after manual lymph drainage or self-drainage in order to maintain and protect the volumetric reduction achieved by lymphatic drainage (29).

Compression bandages: Short tension compression bandages are intended to apply a lower resting pressure. Unlike longer stretch bandages, which are more elastic, compression bandages do not compress skin folds and do not compress around the joint (Figure 3). Compression bandages are accompanied by limb movement and the muscles are actively contracted. Compression bandages

provide stable support so that the muscles can contract more effectively. As a result, lymphatic pumping, lymphatic flow and venous flow increase**.**

Figure 3: Bandages used in lymphedema tratment

It contributes to the realization of more edema absorption by reducing capillary filtration (7).

Compression garment: The role of compression garments in lymphedema is to increase the pressure of the tissue by creating external pressure and to increase reabsorption in the lymph sinuses by preventing the escape of ultrafiltrate from the lymph capillaries. For the upper extremity, fingertip open/closed glove model, shoulder supported or unsupported wrist model compression (compression) clothing can be preferred. The pressure is classified as light, medium, high and very high (Figure 4). Although it is recommended according to the lymphedema staging, comorbid diseases and general condition of the patient, medium-pressure, high-tolerance compression garments between 20 and 60 mmHg are generally preferred (27). In lymphedema, which is a chronic disease, it is important to use compression garments for a long time and to change them at intervals of 4-8 months. In cases where it is deemed necessary during its renewal, it can be returned to Phase 1 so that the edema does not progress (30).

Figure 4. Compression garments

Exercise: Combined exercise and compression therapy are applied to increase the effectiveness of the treatment in Phase 1 and Phase 2 of CDT. Exercise and muscle activities stimulate venolymphatic return with the external pressure they provide on the vessels (31). Exercises should be programmed and applied according to the needs of the patient as breathing, joint range of motion (shoulder, elbow, wrist) combined with breathing, pumping, stretching and endurance-enhancing exercises, and aerobic conditioning exercises, respectively (32). Exercise activates the musculoskeletal pump mechanism, increasing venous and lymphatic return in the affected extremity. In addition to upper extremity exercises, it is thought that cervical region and back region exercises suppress the sympathetic nervous system activity that stimulates lymphatic vessels and thus are beneficial in the long-term treatment process with lymphedema (33).

Skin care: Applications protecting skin integrity are necessary for both phases of CDT. Healing and care of damaged or thinned skin in phase 1 (excretory phase); In phase 2 (protection phase), it is aimed to continue the skin care gained. The lymphedema patient should check the affected body parts twice a day. Conditions such as any cut, redness, temperature increase or increased swelling that disrupt the integrity of the skin are important in terms of controlling the presence of infection. Since immune functions are weak in lymphedema patients, skin integrity should always be protected and skin problems should be carefully managed. Skin care of the extremity with lymphedema should be done very carefully in order to prevent infections (29).

Patients to protect skin integrity;

- Protect the lymphedema area from trauma and injuries
- Protect itself from mosquito bites, pet injuries
- When there is an incision in the lymphedema area, it should be washed with neutral pH soap and water
- Should not come into direct contact with the sun
- Should not prefer clothes and jewelry that will squeeze
- Keeping the arm clean (neutral pH, water-based hygiene products should be used)
- Affected areas should not be scrubbed in the shower, and very hot water should not be used
- Must wear gloves for the risk of cuts while dealing with house and garden chores
- Should not carry heavy loads
- Injection should not be made in the affected arm, blood pressure should not be measured
- Compelling activities and exercises should not be done, a physiotherapist should be consulted for an appropriate exercise program
- Attention should be paid to signs of infection such as redness, fever, increased edema, temperature increase in lymphedema extremities and a doctor should be consulted they should follow their recommendations (28).

KINESIO TAPING METHOD

The use of kinesio taping to contribute to lymph drainage in the treatment of lymphedema is a fairly new approach in the field of physiotherapy and rehabilitation. In the treatment of lymphedema, the lymphatic fluid under the skin is drained to the desired area by using the kinesio taping “lymphatic correction technique” (34). Joint movement restriction in the shoulder region after breast cancer surgery; Incision scar after surgery may develop as a result of the patient’s antalgic posture developed by the instinct of protecting the affected area and avoiding pain. The reduction in lymphedema volume occurs with the treatment components of positioning, MLD, and compression garments; however, when tissues become fibrotic, they are less likely to respond to treatment. Current evidence suggests that early intervention is more effective when soft tissue abnormalities consist predominantly of reducible lymphatic

fluid (especially before fibrosis develops) (35). In the kinesio taping method, the traction direction is directed to ensure that the lymphatic fluid flow is drained in the desired direction. With this technique, healing in tissue by creating a positive effect on peripheral blood and lymph flow It is aimed to accelerate the process and prevent the accumulation of lymph fluid. Lymphatic structures located close to the skin surface are elevated with the kinesio taping method, thereby reducing the lymphatic pressure. As a result, the function of superficial and deep lymphatic structures is improved (36). Literature studies on the kinesio taping method suggest that it provides volume reduction, especially in patients with mild lymphedema. It is also observed that it softens the skin and reduces adhesions in hardness due to scar tissue or radiotherapy. Kinesio tape application performed by physiotherapists trained in this field is effective in relieving pain, hypersensitivity, lymphatic congestion, regulating subcutaneous fluid flow, and increasing blood and lymphatic fluid flow (34).

2.3. Low Level Laser Therapy

In the treatment of upper extremity lymphedema after breast cancer treatment; A low-power laser or light-emitting diode-"light emitting diode" (LED) treatment is applied, which are rays with a wave length that will penetrate the tissue without generating heat. It has been reported that infrared laser devices are effective in reducing the volume in lymphedema, promoting tissue repair, reducing inflammation, reducing the edema volume and initiating analgesia (37).

2.4. Pneumatic Compression Therapy

The pneumatic compression device is used to increase the effectiveness of complex decongestive therapy by providing mechanical compression to the lymphedema extremity. Considering the literature, pneumatic compression application, the use of which has been quite controversial recently, is used in combination with complex decongestive therapy. However, it is a method that supports the process and does not constitute an alternative to complex decongestive treatment (38). The duration of treatment with a compression device in lymphedema can vary from 30 minutes to 6-8 hours, depending on the lymphedema stage of the patient. The use of the compression device is contraindicated in cases of arm infection, anticoagulant use, and deep vein thrombosis. With pneumatic compression therapy, uniform pressure or pressure

at different rates can be applied to the extremity. The devices are capable of applying 0–300 mmHg pressure. Pressures of 30-60 mmHg are generally preferred in the treatment. Looking at the literature, pressure can be applied as maximum 60 mmHg, and higher pressures can damage the lymphatics. Although pneumatic compression treatments have been widely used in the past years, the use of pneumatic compression devices in the treatment of lymphedema has been discussed recently. The device removes tissue fluid from the interstitial space with the pressure provided by the pump effect in the affected extremity, but the proteins remain. After the application, the edema decreases, but because the remaining proteins reabsorb the tissue fluid, edema occurs or the existing edema increases. In devices without body apparatus, edema accumulates in the body as the edema is directed proximally. When applied with high pressure, it can damage the intact lymphatic structures in the skin by causing traumatic tissue injuries (32,39).

REFERENCES

1) Tatar KK, Turhan B. The effects of complex decongestive therapy on pain and functionality in individuals with breast cancer who developed adhesive capsulitis due to lymphedema: an evaluation by an isokinetic computerized system. Korean J Pain. 2022 Jul 1;35(3):280-290.

2) Kelly D. A Primer on Lymphedema. Upper Saddle River, NJ: Prentice Hall; 2002:3– 84.

3) Bruna J, Miller AJ, Beninson J. A simple clinical classification of lymphedema. Eur J Plast Surg. 1999;22:404-5.

4) Michelini S. Lymphedema etiology, epidemiology and clinical staging. In: Michelini S, Failla A, Moneta G, Cardone M (eds). Compression therapy in lymphatic Insufficiency. Cizeta-Medicali, 2010, Milano, p:14-18.

5) DiSipio T, Rye S, Newman B, et al. Incidence of unilateral arm lymphoedema after breast cancer: a systematic review and meta-analysis. Lancet Oncology. 2013;14:500–515.

6) Shah C, Vicini FA. Breast cancer-related arm lymphedema: incidence rates, diagnostic techniques, optimal management and risk reduction strategies. Int J Radiat Oncol Biol Phys 2011;81(4):907-914.

7) Földi M, Kubik S. ML/KPE bei primaeren und sekundaeren lymphödemen sowie weiteren ausgewaehlten Krankheitsbilderen, ‘Lehrburch der Lymphologie’.Urban&Fischer. München, 2001:568-584.

8) Petrek JA, Pressman PI, Smith RA. Lymphedema: Current issues in research and management. CA Cancer J Clin. 2000;50:292-307.

9) Földi E, Földi M, Lymphostatische krankheitsbilder. In: Foldi M, Kubik S, editors. Lehrbuch der lymphologie, 5th ed. Munchen: Urban Fischer,2002:254-347.

10) Warren AG, Janz BA, Slavin SA, et al. The use of bioimpedance analysis to evaluate lymphedema. Ann Plast Surg 2007; 58:541-543.

11) Greene AK, Goss JA. Diagnosis and Staging of Lymphedema. Semin Plast Surg 2018;32:12–6.

12) Cornish BH, Chapman M, Hirst C, et al. Early diagnosis of lymphedema using multiple frequence bioimpedeance. Lymphology 2001; 34:2-11.

13) Deltombe T, Jamart J, Recloux S, et al. Reliability and limits of agreement of circumferential, water displacement, and optoelectronic. Lymphology 2007; 40:26-34.

14) Kurz I. Textbook of Dr Vodder's manual lymph drainage, Vol 3 Treatment Manual. Heidelberg: Karl S. Haug Publishers, 1990.

15) Megens AM, Harris SR. Physical therapist management of lymphedema following treatment for breast cancer: a critical review of its effectiveness. Phys Ther 1998; 78:1302-1311.

16) International Society of Lymphology Executive Committee. The Diagnosis and Treatment of Peripheral Lymphedema. Lymphology 2003;36:84-91.

17) Berebichez-Fridman R, Deutsch YE, Joyal TM, Olvera PM, Benedetto PW, Rosenberg AE, Kett DH. Stewart-Treves Syndrome: A case report and review of the literature Case Rep Oncol 9: 205-211, 2016.

18) Foeldi M. Anatomy of the Lymphatic System. In Foeldi M, Foeldi Textbook of Lymphology. Munich: Urban and Fischer; 2006.

19) Bernas MJ, Witte CL, Witte MH. The diagnosis and treatment of peripheral lymphedema: draft revision of the 1995 Consensus Document of the International Society of Lymphology Executive Committee for discussion at the September 3-7,2001, XVIII International Congress of Lymphology in Genoa, Italy. Lymphology 2001;34(2):84–91.

20) Gebruers N, Verbelen H, De Vrieze T, et al. Current and future perspectives on the evaluation, prevention and conservative management of breast cancer related lymphoedema: A best practice guideline. Eur J Obstet Gynecol Reprod Biol 2017;216:245–53.

21) Devoogdt N, Van Kampen M, Geraerts I, et al. Different physical treatment modalities for lymphoedema developing after axillary lymph node dissection for breast cancer: A review. Eur J Obstet Gynecol Reprod Biol 149:3-9, 2010.

22) Rose KE, Taylor HM, Twycross RG. Long-term compliance with treatment in obstructive arm lymphoedema in cancer. Palliat Med 1991; 5:52-55.

23) Hutzschenreuter P, Weissleder H. Manuelle Lymphdrainage Qualitaetsmanagement-Qualitatssicherung und Qualitatskontrolle, LymphForsch 1999;3:7-10.

24) Leduc O, Leduc A, Bourgeosis P, et al. The physical treatment of upper limbedema. Cancer. 1998;83:2835-9.

25) Lee Y, Mak S, Tse S, et al. Lymphoedema care of breast cancer patients in a breast care clinic: a survey of knowledge and health practice. Supportive care in cancer. 2001;9(8):634-41.

26) The diagnosis and treatment of peripheral lymphedema: 2016 consensus document of the International Society of Lymphology. *Lymphology.* 2016;49:170–84.

27) Badger C, Preston N, Seers K, et al. Physical therapies for reducing and controlling lymphoedema of the limbs. Cochrane Database Syst Rev 2004;18:CD003141.

28) Brian D, Tammy E, Peter A. Lymphedema: A primer on the identification and management of a chronic condition in oncologic treatment. Lymphedema in Cancer,2009; 59(1): 8-24.

29) Asmussen, P.D, Strössenreuther, R.H.K. Compression Therapy. In: Földi, M, Földi, E. (Ed.), Földi's Textbook of Lymphology for Physicians and Lymphedema Therapists. 2 nd edition. Munich, Mosby-Elsevier; 2006;563-627.

30) Harris, S.R, Hugi, M.R, Olivotto, I.A, et al. Clinical practice guidelines for the care and treatment of breast cancer: 11. Lymphedema. Canadian Medical Association, 2001;164, (2): 191-199.

31) National Lymphedema Network, Position Paper. The diagnosis and treatment of lymphedema 2011. Avaliable from: URL: http://www.lymphnet.org/pdfDocs/nlntreatment.pdf

32) Cheville AL, McGarvey CL, Pertek JA, et al. Lymphedema management. Semin Radiat Oncol. 2003;13:290-301.

33) McKenzie DC, Kalda AL. Effect of upper extremity exercise on secondary lymphedema in breast cancer patients: a pilot study. J Clin Oncol 2003; 21: 463-6.

34) Kase K, Wallis J, Kase T. Clinical therapeutic applications of the Kinesio taping methods. Kinesio Taping Association, Tokyo, 2003.

35) Lee, J. H, Shin, B. W, Jeong, et al. Ultrasonographic evaluation of therapeutic effects of complex decongestive therapy in breast cancer-related lymphedema, Annals of Rehabilitation Medicine, 2013; 37, 683-689.

36) Steelman VM, Pape T, King CA, et al. Selection of a method to rate the strength of scientific evidence for AORN recommendations. AORN J 2011;93:433-444.

37) Michelini S, Failla A, Moneta G, et al. Treatment of lymphedema with shockwave therapy: preliminary study. The European Journal of Lymphology and Related Problems; 2007;17(51)29.

38) Szuba A, Cooke JP, Yousuf S, et al. Decongestive lymphatic therapy for patients with cancer-related or primary lymphoedema. Am J Med, 2000;109:296–300. doi:10.1016/S0002-9343 (00)00503-9.

39) Uzkeser H, Karatay S, Erdemci B, et al. Efficacy of manual lymphatic drainage and intermittent pneumatic compression pump use in the treatment of lymphedema after mastectomy: a randomized controlled trial. Breast Cancer, 2013 Aug 8 E-pub ahead of print.

CHAPTER III

THE IMPORTANCE OF EARLY BIOCHEMICAL MARKERS FOR PREDITION OF ACUTE RENAL DAMAGE AND MORTALITY IN PATIENTS WITH CORNAVIRUS (COVID-19)

Zeliha TUNCEL[1] & Aysel GÜVEN[2]

[1](Asst.Prof.Dr),University of Health Sciences, Umraniye Training and Reasearch Hospital, e-mail: zelihalaa@yahoo.com
ORCID: 0000-0002-9577-6765

[2](Assoc.Prof. Dr.), Baskent University, Vocational School of Pathology Laboratory, Ankara, Turkey*, e-mail: aguven@baskent.edu.tr,*
ORCID: 0000-0001-7511-7105

1. INTRODUCTION

The coronavirus (Covid-19) pandemic continues to be an important problem worldwide (1,2). In these days, when the Covid-19 infection continues and has not yet been brought under control, clear data on kidney damage will be available after the pandemic. However, the incidence in the first and last published reports so far is very variable and valuable for diagnosis and treatment. In these studies, it is seen that high-risk groups are formed by advanced age, hypertension, diabetes, cardiovascular diseases, chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), immunosuppressive therapy, organ transplant patients, and mortality is high (3-6). According to the data of the World Health Organization (WHO), the number of Covid-19 (+) cases is 4,735,622, the number of deaths is 316,289 and it is seen in 216 regions worldwide (7). The total number of (+) cases reported in Turkey so far is 151,615, the number of intensive care (ICU) patients is 882,

and the number of patients followed up as intubated is 455(8). According to official figures in Turkey, the number of COVID-19 cases is 16,976,729, and the number of recovered patients is 16,788,849. It was announced that 101,327 people lost their lives. It has been reported that 621,970,895 people have recovered and 6,625,286 people have died, out of a total of 642,794,281 cases detected all over the world so far (9). Although it is seen in all age groups, the prognosis for individuals with chronic diseases is severe, and kidney diseases are the leading Acute kidney disease (AKI), which is generally defined as sudden and continuous deterioration of kidney functions, causes a significant increase in the morbidity and mortality of hospitalized patients, especially in intensive care units (10). AKI mortality is reported as 28-90%, and the incidence of end-stage renal disease is 11-16% (3,5,6). AKI is a clinical picture that results in the inability to remove urea and other nitrogenous waste products from the body due to the sudden loss of function in the kidney, and the deterioration of the extracellular fluid volume and electrolyte content. Although the incidence of AKI varies according to age, it is considered to be less than 1% in the general population, 2-7% in hospitalized patients and 5-30% in intensive care patients. While the mortality rate is 5-10% in uncomplicated AKI, it is between 40-90% in patients hospitalized in the intensive care unit. The worst prognosis is when it is associated with sepsis (11). The lack of consensus on the diagnosis of AKI and the existence of over 35 different definitions currently in use create great variability in reported frequency and mortality rates. It is predicted that the validity of the criteria based on the determination of the severity of AKI will weaken in diseases with a complex pathogenesis such as septic AKI and in groups with high mortality, and regulation by including the etiology will increase their applicability in clinical practice. Based on the need for diagnostic standardization, the evaluation of early biochemical markers to predict acute kidney injury and mortality in patients hospitalized in intensive care unit with pre-diagnosis/diagnosis of Coronavirus (COVID-19) in line with the widespread consensus of experts: serum creatinine, serum Cystatin-C, plasma neutrophil gelatinase-associated lipocalin. (N-GAL) comparison was made. Of these biomarkers, the most promising are serum NGAL (notrophyl gelatinase-associated lipocalin), cystatin C, IL-18, and KIM-1 (kidney injury molecule). These molecules have been shown to be effective in many clinical conditions such as bypass surgery for the diagnosis of AKI, heart failure, and contrast-dependent renal failure (12-14).

2. COVID-19 AND ACUTE RENAL FAILURE

Acute kidney injury is a common condition in patients with different critical illnesses. Therefore, it is accepted as a negative prognostic factor marker for disease severity and survival, which affects approximately 20-40% of COVID-19 patients (15). Because the accumulation of SARS-CoV virus fragments in both blood and kidneys by Polymerase Chain Reaction (PCR), and similarly, detection of COVID-19 fragments by the same methods shows the cytopathic effects of these viruses. It is claimed that the new coronavirus uses angiotensin-converting enzyme 2 (ACE2) as a cell entry receptor due to its high affinity like SARS-CoV, and that this receptor is approximately 100 times more potent in kidney tissue compared to lungs, and that high expression of this receptor may play a role by increasing cellular sensitivity (16,17).

This virus, named Coronavirus 2 SARS-CoV-2, which emerged in Wuhan, China and caused the disease called Covid-19, spread to almost all countries of the world and caused a high number of deaths in a very short time (1,2). It is a zoonotic infection caused by the SARS-CoV-2 agent. SARS-CoV-2 infection; It has a wide clinical spectrum, including asymptomatic infection, mild upper respiratory tract disease, respiratory failure due to severe viral pneumonia, and even death (18). Using the virus RNA, the infected cell begins to produce proteins that will keep the immune system off and help make new copies of the virus. The process is dynamic and new discoveries and changes can happen at any time.

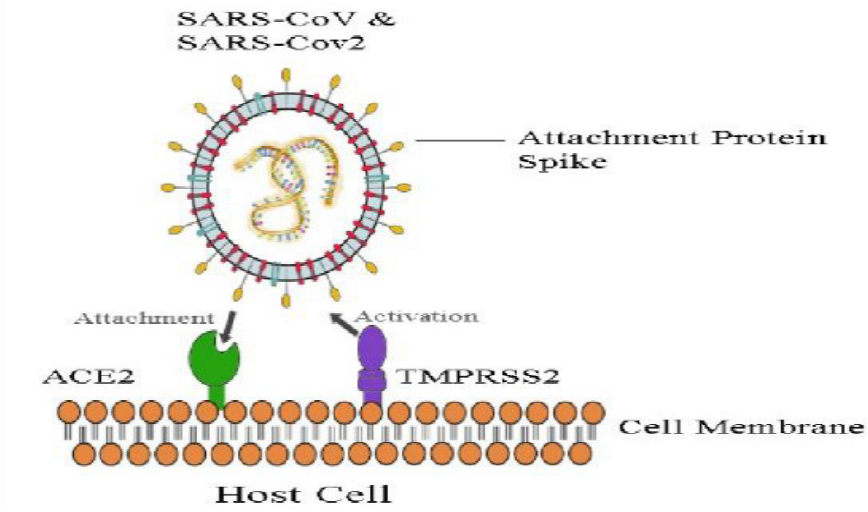


Figure 1. Mechanisms of coronavirus cell entry (2).

Indeed, the presence of SARS-CoV-2, RNA, and the excretion of live SARS-CoV-2 in the urine of COVID-19 patients indicate that the virus interacts directly with the renal tubules. In addition, the presence of SARS-CoV-2 viral particles in kidney samples taken in autopsies can also be put forward as evidence(19). It is likely that the Virus infects the renal parenchyma by first invading podocytes and then binding ACE-2 in the proximal tubule. Studies have shown with postmortem data that it cannot be induced by active SARS-CoV-2 replication in proximal tubule cells that express high levels of ACE2, supporting that kidney failure develops by this mechanism (20,21).

While most patients have mild symptoms of COVID-19, about 5% of patients develop severe symptoms such as acute respiratory distress syndrome, septic shock, and multiple organ failure. These include acute kidney injury (AKI) and acute kidney failure (ARF). While approximately 20-40% of these patients are affected by COVID-19, it is accepted as a negative prognostic factor marker for disease severity and survival (22).

The rates of acute kidney failure (ARF) due to Covid-19 are 5.1.14%, 8.15%, 21.16% and 2717%. There is also a multifactorial interaction such as dehydration, nephrotoxic agents, mechanical ventilation, direct renal cell damage with immune mechanisms, fever, but the most important mechanism triggering pandemic-associated acute kidney injury (AKI) is thought to be cytokine storm. This suggests that renal involvement is associated with possible mechanisms such as cytokine storm due to sepsis, hypoxia, secondary infections with bacteria, fungi or other viruses, drug-related nephrotoxicity, direct cellular injury due to virus (19,23). This phenomenon is considered to be the period when inflammatory markers are elevated and symptoms and symptoms such as fever, muscle pain, respiratory distress appear fluctuating.

The development of AKI in COVID-19 is explained by different mechanisms such as viral cytopathic effect in renal cells and hyperinflammatory response of the host. Renal dysfunction may aggravate the lung-onset inflammatory state in these patients. This may trigger multiorgan failure (24).

About 20% of patients admitted to the intensive care unit (ICU) with COVID-19 require renal replacement therapy (RRT) after an average of 15 days from disease onset. Early recognition of kidney involvement in COVID-19 and the use of preventive and therapeutic measures to limit later AKI or progression to more serious stages have been important to reduce morbidity and mortality. The cause of kidney involvement in COVID-19 is multifactorial, cardiovascular comorbidity is largely one of the most important causes. Considering the high

incidence of renal involvement in COVID-19, early diagnosis to support kidney function and considering all available treatment options are important for mortality (11). In a study conducted in Italy, it was reported that 480 of 3200 Covid19 cases had an underlying chronic disease, and chronic kidney failure was the fifth with 20.2% (n=97) in the underlying disease ranking (25).

3. BIOCHEMICAL MARKERS FOR THE EARLY DIAGNOSIS OF ACUTE KIDNEY DISEASE (ABD)

Good results are obtained as a result of studies on many different biomarkers in order to diagnose AKI in the earliest and most accurate way (26-28). It is stated that proteinuria, hematuria, serum creatinine and blood urea nitrogen (BUN) are high in patients hospitalized due to Covid-19, and proteinuria increases further during the hospital stay(19,28,29). Low molecular weight proteins in the diagnosis of AKI; B2-microglobulin, A1-microglobulin, adenosine, deaminase binding protein, cystatin-C, Renal tubular epithelial antigen, enzymes; N-acetyl-b-glucosaminidase, alanine aminopeptidase, alkaline phosphatase, lactate dehydrogenase, g/n glutathione -S-transferase, G-glutamyl transpeptidase, cytokines; platelet activating factor, IL-18, genes; neutrophil gelatinase associated lipocalin (NGAL) and kidney injury molecule-1 were determined as Na/H exchanger isoform-3. However, the creation and validation of these biomarker panel combinations is needed for the early diagnosis of AKI. Due to the lack of a proven treatment regimen, it is particularly important to closely monitor kidney function in acute kidney injury patients with severe COVID-19 infection, avoid nephrotoxins, and minimize studies and interventions that could potentially damage the kidneys. For this reason, it is important to reveal the relationship between COVID-19 and AKI by examining the results of serum cystatin C and urine/plasma NGAL and other biomarkers, which are thought to guide researchers in clinical studies to be conducted for its improvement and treatment.

Serum creatinine:

Traditionally, increase in serum creatinine levels or detection of oliguria are used in the diagnosis of AKI (27,30). However, it is accepted that creatinine, which we use in our daily practice, is a weak marker to show acute worsening in kidney functions. Because body weight is affected by many non-renal factors such as race, age, gender, body fluid volume, various drugs, muscle metabolism and protein intake (31).

Liu et al. (32) analyzed 36 studies with a total of 6395 COVID-19 patients in their review, and analyzed 36 studies in the severe group compared to the non-severe group with pre-existing CRF (OR = 3.28), complication of AKI (OR = 11.02), serum creatinine (SMD = 0.68), suggested significantly higher levels of abnormal serum creatinine (OR = 4.86), BUN (SMD = 1.95), abnormal BUN (OR = 6.53), continuous renal replacement therapy (CRRT) (OR = 23.63). They also state that the complication of AKI (OR = 13.92) and BUN (SMD = 1.18) increased significantly in the critical group compared to the severe group. However, since it has been shown that creatinine may increase with a delay following the development of acute kidney injury, it has been suggested that the supportive treatments that should be initiated are delayed (27,30). In addition, although such patients have significant renal damage, the change in serum creatinine level may be minimal or absent due to creatinine reserves and tubular secretion (33). Therefore, there is a need for new and early diagnosis diagnostic tests for the diagnosis of acute renal failure, just as in the diagnosis of myocardial infarction (27). Therefore, new biomarkers have recently been introduced for earlier and more specific (34).

Serum cystatin C:

Cystatin C, Cystatin-C 13-kDa is a non-glycosylated protein secreted from all nucleated cells and is a 13.3-kDa non-nicholysed cysteine protease inhibitor that is freely filtered from the glomeruli and catabolized in the tubules (35) and released into the intravascular compartment at a constant rate (serum level: 0.8–2.04 mgL). Serum CysC (sCysC) levels can be affected by gender, race, muscle mass, and hydration status, as well as in thyroid dysfunction, smoking, inflammation, some cancers and glucocorticoids, and viral diseases. In the prediction of AKI, serum and urinary cystatin C have been reported to show sensitivity and specificity of 0.84 and 0.82, and 0.52 and 0.70, respectively. Studies have shown that cystatin C has diagnostic value when measured early (within 24 hours of critical care unit admission) and is also useful for predicting dialysis need and death. Studies show that Cystatin-C values are significantly higher in patients who are hospitalized in the intensive care unit and develop AKI, compared to the control group (36-38). This is a result that supports the importance of early diagnosis. In another study, the highest relative risk for cystatin C was found to be 1.21 mg/dL. At this point, the sensitivity is 82.86%; positive predictive value was 100%, negative predictive value was 50%, and the area under the ROC curve (AUC) was 93.3%(36). In a study by Royakeers,

which included 150 patients, it was stated that cystatin-C was a Lipocalin. (N-GAL) (35).

Lipocalin.(NGAL):

NGAL is a glycoprotein found covalently bound to neutrophil gelatinase, usually in human neutrophils. It is an extracellular protein that can bind small, hydrophobic molecules and play a role in cell homeostasis. NGAL performs many vital functions during various processes of development, growth and tumorigenesis (39,40). It is a protein produced by kidney proximal tubule cells, endothelium, smooth muscle cells and leukocytes. Since it is synthesized in epithelial cells, it can also be synthesized in the liver, lungs and intestines apart from the kidney. Therefore, it is physiologically released at very low levels from the kidney, trachea, lung, stomach, pancreas and colon. However, in cases of inflammation, its secretion increases as a result of endothelial cell damage. NGAL is a proinflammatory molecule. There is accumulation of granulocytes in the inflamed area. After apoptosis of granulocytes, secretory granules containing NGAL are exposed and mediate local tissue damage.

NGAL is a 25 kDa protein of the lipocalin family. Human NGAL exists as a monomer and a 45-kDa homodimer; it is also conjugated to gelatinase as a 135-kDa heterodimer and is specific for neutrophils (41). NGAL is a 'ready to go gene' that quickly expresses when kidney cells sense stress and/or damage. Much more sensitive than serum creatinine (sCr), NGAL−sCr− (kidney normal), NGAL+sCr− (damage to <50% of kidney mass or early detection of serious disease), NGAL + sCr + (>50% damage) and finally NGAL− sCr + (no renal stress or damage, but functional impairment consistent with prerenal azotaemia) (42). makes you think. Patients with NGAL >104 ng mL−1 and sCr>1.4 mg dL−1 have been shown to have a 15% incidence of death or dialysis at the time of hospitalization. In a meta-analysis conducted by Haase et al., it was found that measuring NGAL 6 hours after patients were seen was significant in predicting AKI and the AUC value was 0.73 (43).

4. CONCLUSION

In all studies conducted to date, it is stated that SARS-CoV-2 virus causes multi-organ complications, including kidney (2,43-45). Studies on various biomarkers are continuing to ensure early and accurate diagnosis of AKI. Serum and urine biomarkers have so far shown good results in large populations. In

a study conducted; 85 ICU patients were examined and it was concluded that Cystatin-C AKI appeared 1-2 days before creatinine (37). Thus, serum cystatin C and plasma and urinary neutrophil gelatinase-associated lipocalin (NGAL) levels were accepted as early biomarkers for AKI, and since it is known that the levels of these biomarkers increase 24-48 hours before serum creatinine levels increase, necessary precautions were taken. Again, when we look at the studies, the increase in serum cystatin C levels as the AKI stage increases, makes the follow-up of the serum cystatin C level very valuable in the follow-up of AKI. In addition, in the analysis of urine, hematuria was found in 2 of 3 cases and proteinuria was found in 3 of 4 cases. In microscopy, 36% of leukocytes and 40% of erythrocytes were seen. Urine density average is 1020. Investigations were performed 24 hours before and 48 hours after the diagnosis of AKI (46).

Early diagnosis of AKI (serum cystatin C and urinary NGAL), diagnosis of established AKI patients (serum cystatin C, urinary IL-18 and KIM-1), dialysis and risk grading needed for mortality (urine KIM-1, NAG and IL) - 18) biomarker series are expected. If these panels are approved and strong results are shown, they will guide researchers in clinical trials to improve outcomes and treatment of AKI.

REFERENCES

1. Güven A. Biological story of the new coronavırus SARS-COV-2. Caucasian Journal of Science, 2022; 9(2):203-214 doi.org/10.48138/cjo.1019435.

2. Güven A, Diken Allahverdi T, Güven ÖD.(2021) Coronavirus: A Biochemical Approach. Sinop Üniversitesi Fen Bilimleri Dergisi, 2021; 6(1):66-77.

3. Brivet, F.G, Kleinknecht D.J, Loirat, P. et al. Acute renal failure in intensive care units--causes, outcome, and prognostic factors of hospital mortality. Critical Care Medicine. 1996;24(2): 192-198.

4. Emami A, Javanmardi F, Pirbonyeh N, Akbari A. Prevalence of Underlying Diseases in Hospitalized Patients with COVID-19: a Systematic Review and Meta-Analysis. Arch Acad Emerg Med. 2020; 24 (8): 35-41.

5. Metnitz P.G, Krenn C.G. Steltzer H. et al. Effect of acute renal failure requiring renal replacement therapy on outcome in critically ill patients. Crit Care Med.2002; 30: 2051-2058.

6. Uchino S, Kellum J.A. Bellomo R et al. Acute renal failure in critically ill patients: a multinational, multicenter study. JAMA.2005; 294: 813-818.

7. World Health Organization Director General's opening remarks at the media briefing on COVID-19. WHO; 3 March 2020.

8. Ronco C, Reis T, Husain-Syed F. Management of acute kidney injury in patients with COVID-19 Lancet Respir Med. 2020; 8(7):738-742.

9. https://www.klimik.org.tr/koronavirus/covid-19-salgininda-ulkelere-gore-olgu-sayilari, 2022.

10. Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P. Acute Dialysis Quality Initiative workgroup. Acute renal failure: definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. Crit Care.2004; 8(4): 204-212.

11. Yang H.T, Yim H, Cho y.S, Kym D et al.Of biochemical markers in the early post-burn period for predicting acute kidney injury and mortality in patients with major burn injury: comparison of serum creatinine, serum cystatin-C, plasma and urine neutrophil gelatinase-associated lipocalin. Critical Care .2014; 18:151-262.

12. Sirota JC, Walcher A, Faubel S, Jani A, Mcfann K, Devarajan P, et al.(2013) Urine IL-18, NGAL, IL-8 and serum IL-8 are biomarkers of acute kidney injury following liver transplantation. BMC Nephrol 14:17.

13. Bulent Gul CB, Gullulu M, Oral B, Aydinlar A, Oz O, Budak F, et al.(2008) Urinary IL-18: A marker of contrast-induced nephropathy following percutaneous coronary intervention? Clin Biochem 2008;41:544-7.

14. Mishra J, Dent C, Tarabishi R, Mitsnefes MM, Ma Q, Kelly C, et al. (2005) Neutrophil gelatinase- associated lipocalin (ngal) as a biomarker for acute renal injury after cardiac surgery. Lancet 365:1231-8.

15. Bellomo, R., J. Kellum, and C. Ronco, (2001) Acute renal failure: time for consensus. Intensive Care Med 27: 1685-1688.

16. Peiris JSM, Chu CM, Cheng VCC, et al. (2003) Clinical progression and viral load in a community outbreak of coronavirus-associated SARS pneumonia: a prospective study. Lancet. 361:1767-72.

17. Huang C, Wang Y, Li X, et al.(2020) Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 395: 497-506.

18. Zhou F, Yu T, Du R, et al.(2020) Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. The lancet. 395:1054-62.

19. Su, H, Yang, M, Wan, C, et al.(2020) Renal histopathological analysis of 26 postmortem findings of patients with COVID-19 in China. Kidney Int. 98: 219–227.

20. Perico L, Benigni A, Remuzzi G (2020) Should COVID-19 Concern Nephrologists? Why and to What Extent? The Emerging Impasse of Angiotensin Blockade. Nephron. 144: 213-21.

21. Chu KH, Tsang WK, Tang CS, et al. Acute renal impairment in coronavirus-associated severe acute respiratory syndrome. Kidney Int.2005; 67: 698-705.

22. Bellomo R, Bagshaw SM. Evidence-based medicine: classifying the evidence from clinical trials: the need to consider other dimensions. Crit Care.2006; 10(5):232.

23. Naicker S, Yang CW, Hwang SJ, Liu BC, Chen JH, Jha V. The novel coronavirus 2019 epidemic and kidneys. Kidney Int. 2020;97(5):824-828.

24. Stasi A, Castellano G, Ranieri E, et al. SARS-CoV-2 and Viral Sepsis: Immune Dysfunction and Implications in Kidney Failure. J Clin Med.2020; 15;9(12):4057.

25. Palmieri L, Andrianou X, Bella A, Bellino S, Boros S, Canevelli M, et al. Characteristics of COVID-19 patients dying in Italy report based on available data on March 20th, 2020. https://www.epicentro.iss.it/coronaviru s/bollettino/ Report-COVID2019_20_marzo_eng.pdf. Erişim Tarihi:19.05.2022.

26. Moore E, Bellomo R, Nichol A. Biomarkers of acute kidney injury in anesthesia, intensive care and majör surgery: from the bench to clinical research to clinical practice.Minerva Anestesiol.2010; 76:425-40.

27. Coca, S.G., King, J.T., Rosenthal, R.A., Perkal, M.F. & Parikh, C.R. The duration of postoperative acute kidney injury is an additional parameter predicting long-term survival in diabetic veterans. Kidney Int.2010; 78, 926–933.

28. Li Z, Wu M, Yao J, Guo J, Liao X, Song S et al. Caution on kidney dysfunctions of 2019-nCoV patients. 2020. doi: https://doi.org/10.1101/-2020.02.

29. Wang L, Li X, Chen H, Yan S, Li D, Li Y, et al. Coronavirus disease 19 infection does not result in acute kidney injury: an analysis of 116 hospitalized patients from Wuhan, China. American Journal of Nephrology.2020; 51(5):343-348.

30. Mehta RL, Chertow GM. Acute renal failure definitions and classification: time for change? J Am Soc Nephrol 14:2178-87.

31. Bjornsson TD (1979) Use of serum creatinine concentrations to determine renal function. Clin Pharmacokinet.2003; 4:200-22.

32. Liu YF, Zhang Z, Pan XL, et al. The chronic kidney disease and acute kidney injury involvement in COVID-19 pandemic: A systematic review and meta-analysis. PLoS One.2021; 16(1):e0244779.

33. Herrera J, Rodriguez-Iturbe B. Stimulation of tubular secretion of creatinine in health and in conditions associated with reduced nephron mass. Evidence for a tubular functional reserve. Nephrol Dial Transplant. 1998; 13:623-9.

34. Kim H, Hur M, Cruz DN, Moon HW, Yun YM. Plasma neutrophil gelatinaseassociated lipocalin as a biomarker for acute kidney injury in critically ill patients with suspected sepsis. Clin Biochem. 2013; 46:1414-8.

35. Royakkers AA, Korevaar JC, van Suijlen JD, Hofstra LS, Kuiper MA, Spronk PE, et al. Serum and urine cystatin C are poor biomarkers for acute kidney injury and renal replacement therapy. ntensive Care Med.2011; 37:493-501.

36. Kaya Gencel D, Ergin Özcan P, Achmet A Ali, Orhun G, Şentürk E, Akıncı I.O, Nahit Çakar. Cystatine C in the Early Diagnosis of Acute Kidney Injury Turk Yogun Bakım Derneği Dergisi. 2013; 11: 101-105 DOI: 10.4274/Tybdd.36844.

37. Herget-Rosenthal S, Marggraf G, Husing J, Goring F, Pietruck F, Janssen O, et al. Early detection of acute renal failure by serum cystatin C. Kidney Int. 2004; 66:1115-22.

38. Ahlstrom A, TallgrenM, Peltonen S, Pettila V. Evolution and predictive power of serum cystatin C in acute renal failure. Clin Nephrol. 2004;62:344-50.

39. Candido S, Maestro R, Polesel J, Catania A, Maira F, Signorelli SS et al. Roles of neutrophil gelatinase-associated lipocalin (NGAL) in human cancer. Oncotarget. 2014; 5:1576–94.

40. Bolignano D, Donato V, Lacquaniti A, Fazio MR, Bono C, Coppolino G et al. Neutrophil gelatinase-associated lipocalin (NGAL) in human neoplasias: A new protein enters the scene. Cancer Lett. 2010; 288:10–6.

41. Soni SS, Cruz D, Bobek I, Chionh CY, Nalesso F, Lentini P, de Cal M, Corradi V, Virzi G, Ronco C. Int Urol Nephrol. 2010; 42(1):141-50. doi: 10.1007/s11255-009-9608-z.

42. Çivilibal M, Yavaş Aksu B. Güncel Kılavuzlar Eşliğinde Akut Böbrek Hasarı. Haseki Tıp Bülteni, Galenos YayInevi by Galenos Publishing. 2015. DOI:10.4274/haseki.2579.

43. Haase M, Bellomo R, Devarajan P, Schlattmann P, Haase-Fielitz A. NGAL Meta-analysis Investigator Group.Accuracy of neutrophil gelatinaseassociated lipocalin (NGAL) in diagnosis and prognosis in acute kidney injury: a systematic review and meta-analysis. Am J Kidney Dis. 2009; 54:1012-24.

44. Hirsch JS, Ng JH, Ross DW, et al. Acute kidney injury in patients hospitalized with COVID-19. Kidney Int. 2020; 98(1):209-218.

45. Karadeniz, Z, Tuncel Z, Nihan Yapıcı, Türkan Kudsioğlu,et al. Akut Böbrek Hasarının Erken Tanısında Plazma NGAL (Neutrophil Gelatinase-Associated Lipocalin) Etkinliğinin Off-pump ve On-pump Kalp Cerrahisinde Karşılaştırılması. GKDA Derg.2013; 19(4):168-174, 2013 doi:10.5222/GKDAD.2013.1684.

46. Hirsch JS, Ng JH, Ross DW, et al. Acute kidney injury in patients hospitalized with COVID-19. Kidney Int. 2020; 98(1):209-218.

CHAPTER IV

ENVIRONMENTAL HEALTH AND DISASTERS

Serap SALİMOĞLU

Başkent University, Vocational School of Health Services, Ankara, Turkey,
e-mail: sbaytar@baskent.edu.tr,
ORCID: 0000-0003-0589-1538

1. Introduction

Defining the environment is a challenging task due to its complex nature, which encompasses various physical, biological, and social factors. The World Health Organization provides a definition of the environment as "the sum total of all external factors, both natural and human-made, that affect the life and development of an organism". This definition emphasizes the interconnectedness of environmental factors and their impact on health outcomes.

The significance of the environment on health is a complex concept that has been increasingly acknowledged in recent years. Healthcare professionals have recognized the importance of environmental health as they endeavor to comprehend and tackle the environmental aspects that lead to health issues.

Disasters are events that cause disruptions to the normal functioning of communities and inflict significant damage to life and property. Disasters can result in various health problems such as injuries, infectious diseases, mental health disorders, and malnutrition. Moreover, these health problems may persist long after the disaster has occurred.

The impact of disasters is a matter of concern for scholars and policymakers. To reduce the impact of disasters and create resilient communities, disaster preparedness and prevention measures, as well as coordinated efforts among different sectors are needed. Investing in disaster risk reduction can save lives, reduce the economic impact of disasters, and contribute to achieving the

Sustainable Development Goals. A "whole-of-society" approach to disaster risk reduction is needed.

2. Environment and its Relation to Health

The term "environment" refers to both natural and built surroundings where individuals live, work, and interact. The definition of environment provided by Last's "A Dictionary of Epidemiology" is "all that which is external to the individual host", and it includes various physical, biological, and social elements that can influence an individual's health (1).

As shown in Figure 1 below, one way to depict the environment is to start with the most comprehensive definition and then gradually move towards more specific ones:

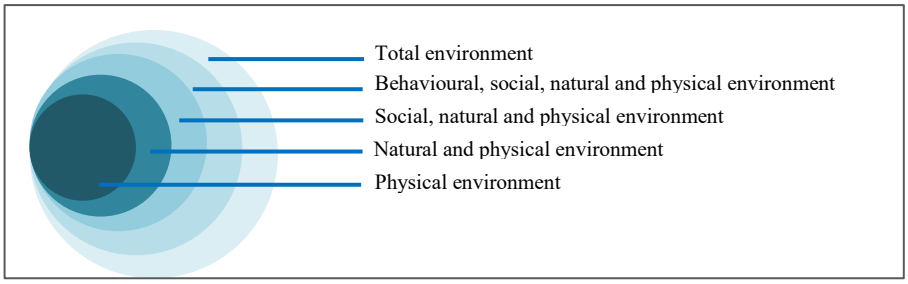


Figure 1: Definition of Environment (2)

The idea of the environment in relation to health is complex and encompasses physical, biological, and social factors that can impact an individual's health. The environment plays a significant role in human health, given its potential to induce, augment susceptibility to, worsen, and facilitate the spread of diseases. For a disease to occur, multiple factors must be present and operate together in three categories: agent, host, and environment. The "epidemiological triad" describes the interaction of these three factors that lead to disease development (3). Understanding these different types of environments is key to identify and address environmental health problems.

The impact of environmental factors on public health has been extensively studied in the healthcare and public health field. Environmental factors such as air pollution, water quality, and sanitation are major determinants of health globally and contribute to the burden of disease (4).

In addition, research indicates that the built environment, which encompasses urbanization and industrialization, can have an impact on health

outcomes. Hence, possessing knowledge about diverse environmental factors that can influence health and devising preventive measures and public policies based on such information is imperative for healthcare professionals (5,6).

3. Problems concerning the Environmental Health

Within the domain of environmental health, multiple risk factors contribute to an individual's vulnerability to environmental hazards, including genetic predisposition and pre-existing health conditions such as diabetes or heart disease, which may intensify the deleterious effects of air pollution (7,8). Furthermore, social determinants of health, including restricted access to healthcare and poverty, can also increase susceptibility to environmental hazards (9,10).

Therefore, it is crucial to consider a person's genetic background and other risk factors when assessing the potential health impacts of environmental hazards to identify those at greater risk and develop targeted interventions to mitigate harm. The association between the environment and human health is intricate and encompasses diverse physical, biological, and sociocultural components. Understanding these interrelationships is crucial for preventing diseases and promoting public health.

Clean air, stable climate, access to safe water, proper sanitation and hygiene, the safe use of chemicals, protection from radiation, safe workplaces, health-supportive cities and built environments, and preserved nature are some of the essential environmental factors that contribute to good health. As stated by the World Health Organization, modifiable environmental hazards account for approximately 13.7 million deaths every year, which is equivalent to 24% of global fatalities. This highlights the urgency for improved environmental conditions to prevent such fatalities (11,12).

Promoting healthy aging is a key objective of European health policy. Recently, the concept of active and healthy aging has been approached through a Planetary Health perspective, emphasizing the environmental threats to human health and the interconnection between human health and the sustainability of the planet (13). Older adults are particularly vulnerable to various risk factors, including food contamination through water or soil, air pollution, and hazards related to climate change. The aging population's long-term exposure to environmental hazards may increase their physiological vulnerability and susceptibility to social inequalities, making these risks even more significant for this demographic (14-16).

In 2022, the United Nations General Assembly acknowledged access to a clean, healthy, and sustainable environment as a fundamental human right, in line with the United Nations Human Rights Council's proclamation the previous year. The aforementioned resolution will empower individuals to advocate for their entitlement to a secure climate, unpolluted air and water, sufficient nourishment, robust ecological systems, and non-hazardous surroundings (17).

In brief, the environment has a crucial role in human health, and its impact can be categorized into three main groups: physico-geochemical, biological, and sociocultural. Physico-geochemical elements, including water, waste, shelter, and climate, can affect human health, as well as biological agents such as microorganisms, parasites, and fungi. Sociocultural factors, such as social, cultural, and economic aspects, can also significantly impact human health positively or negatively. Therefore, environmental exposure, which encompasses all external effects on an individual, is an essential consideration in maintaining human health (18).

4. Definition of Disaster and Types

A range of factors can affect the health of living organisms, including humans, and fall under the umbrella of environmental health issues. These factors include preventing environmental pollution, controlling infectious diseases, ensuring the health and safety of housing, and mitigating the effects of climate change. Natural disasters, such as floods, droughts, storms, winds, and extreme heat, occur in various regions globally and can have negative consequences on life. Natural disasters have been a longstanding concern among scientists, and it is crucial to define and comprehend the nature of a disaster to effectively address its impact (19).

As defined by the United Nations Office for Disaster Risk Reduction (UNDRR), a disaster is a multifaceted phenomenon that results from the interplay of a hazardous event, exposure, vulnerability, and capacity. This interaction can lead to significant losses and impacts on various aspects of human, material, economic, and environmental wellbeing (20). The hazards that can trigger disasters are diverse and include both natural events, such as earthquakes, floods, and wildfires, as well as human-made events, such as industrial accidents and terrorist attacks (21).

According to UNDRR, vulnerability refers to the traits of individuals and communities that increase their susceptibility to harm, while exposure refers to the degree to which people and assets are at risk of harm. For example, individuals residing in low-lying areas or substandard housing are more vulnerable to flooding or earthquake damage than those living in higher elevations or well-

constructed buildings. Capacity refers to the available resources and abilities of individuals and communities to prevent, prepare for, respond to, and recover from disasters (22). In other words, the presence of early warning systems, emergency response plans, and community preparedness programs can enhance a community's capacity to withstand a disaster. It is essential to comprehend the intricate interaction among hazards, exposure, vulnerability, and capacity to promote disaster risk reduction efforts effectively.

The definition of disasters as stated by Akdur refers to ecological occurrences that disrupt the regular operations of a community or society, resulting in substantial loss of life and property and necessitating outside assistance (23). According to Çağatay and Çobanoğlu, any incident that disrupts the social order and causes significant loss of life, injuries, and economic damages is classified as a disaster. Disasters can be classified into two main types: natural and human-induced disasters. Natural disasters include events such as floods, landslides, and gas explosions, and can be further classified into rapid-onset and slow-onset disasters. Human-induced disasters, on the other hand, are the result of intentional or unintentional acts of destruction and violence arising from human activities such as accidents or negligence (24).

Natural disasters are classified into two categories: geophysical and weather-related disasters. Geophysical disasters are caused by the movement of masses, such as earthquakes, volcanic eruptions, landslides, and ground subsidence. Among these, earthquakes are the most prevalent and destructive, as demonstrated by the 2011 Tohoku earthquake in Japan, which triggered a massive tsunami and resulted in extensive damage and loss of life (19,25).

In contrast, weather-related disasters are caused by extreme weather conditions like excessive precipitation, strong winds, and high tides. Precipitation-induced floods are the most significant weather-related disasters. For instance, heavy rainfall caused severe flooding in Kerala, India, resulting in over 440 deaths and economic losses worth over 2.2 billion dollars in 2018 (26).

On the other hand, human-induced disasters include intentional and unintentional acts of destruction and violence resulting from human activities, such as terrorism, wars, technological accidents, or environmental pollution. Such disasters can have severe and long-lasting impacts on affected communities. For instance, the Bhopal gas tragedy in 1984, which killed over 3,500 people and injured thousands, resulted from the accidental release of toxic gas from a pesticide plant in India. Similarly, the Deepwater Horizon oil spill in the Gulf of Mexico in 2010, caused by the explosion of an offshore oil rig, resulted in the release of millions of gallons of oil into the ocean, causing extensive environmental damage and economic losses (27,28).

Figure 3, which presents global natural disaster fatalities in thousands, according to data from Aon in 2023, shows that earthquakes are responsible for the majority of disaster-related deaths in the 21st century. Significant individual catastrophic events occurred in the Indian Ocean (2004), Haiti (2010), Pakistan (2005), China (2008), and Iran (2003). These five events alone caused more than 600,000 fatalities, or roughly a third of all deaths attributed to natural disasters since 2000 (29).

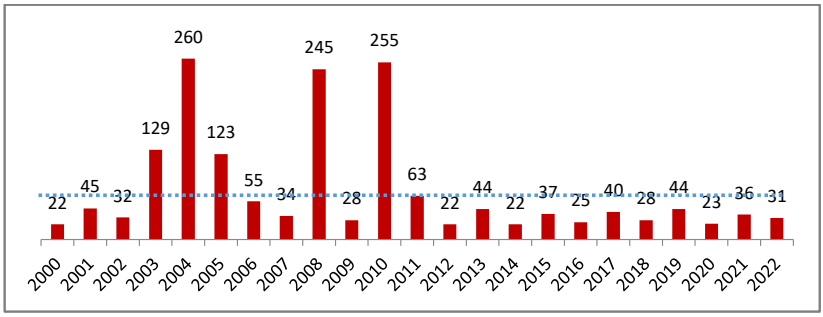


Figure 3: Global Natural Disaster Fatalities (thousands) (29)

Figure 4 here shows the index of deaths resulting from disasters annually between 1980 and 2017.

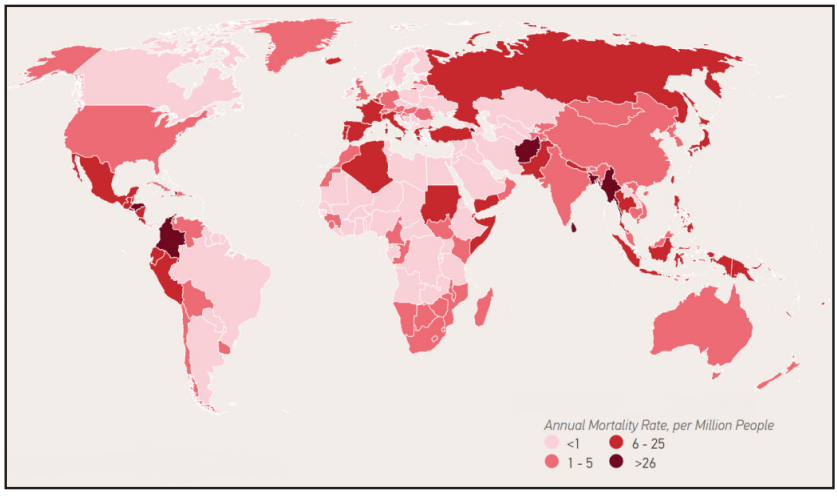


Figure 4: Index of Deaths Resulting from Disasters Annually Between 1980 and 2017 (30)

Turkey is a large country covering over 780,000 square kilometers, with most of its territory situated in Asia, but it also serves as a connection between

Europe and Asia. Its unique geological, meteorological, and topographical structure renders it susceptible to a range of natural disasters. Turkey is located in a seismically active region, making it susceptible to earthquakes. In 1999, a catastrophic earthquake with a magnitude of 7.4 struck the Marmara region of Turkey, leading to the death of over 17,000 individuals and leaving over 200,000 people homeless (31).

Over the period spanning 1980 to 2017, Turkey encountered numerous natural disasters resulting in significant loss of life. During this timeframe, an average of 6-25 people per year per one million people in Turkey lost their lives due to natural disasters such as earthquakes, landslides, floods, rockfall, and avalanches. On February 6, 2023, a catastrophic earthquake with a magnitude of 7.7 on the Richter scale occurred in the Pazarcık district of the Kahramanmaras province, Southern Turkey, causing widespread devastation. The earthquake had significant impacts on the neighboring provinces of Adıyaman, Kilis, Osmaniye, Gaziantep, Malatya, Şanlıurfa, Diyarbakır, Adana, and Hatay, where approximately 15 million people. Many aftershocks occurred after the earthquake, and a second major earthquake with a magnitude of 7.6 hit the region nine hours later, leading to further damage and destruction of already damaged buildings (30,32).

The United Nations Office for the Coordination of Humanitarian Affairs forecasts that the number of disaster events worldwide will escalate to 560 per annum, equating to 1.5 events daily, which represents a 40% increase in only 15 years. It is predicted that developing countries and vulnerable communities, including women and girls, will bear the brunt of these disasters with higher mortality rates, displacement, gender-based violence, economic losses, education losses, and child marriages (33).

5. Impacts of the Disasters

Disasters can have extensive effects on both human and natural systems. Natural disasters such as earthquakes, hurricanes, and floods can lead to the loss of life and property damage, as well as the destruction of infrastructure, crops, and livestock. The aftermath of disasters can also lead to indirect effects such as decreased availability of resources for intervention and increased costs of first aid and treatment, which can cause disruptions in other essential services.

Disasters can have both direct and indirect effects on human and natural systems. Direct effects include loss of life and property, injuries, housing problems, damage to the economy, loss of animals and their injuries, loss

of agricultural products, damage to infrastructure, first aid, and damage to cultural heritage. Indirect effects arise as a result of direct effects and can cause disruptions in other essential services such as investments in the economy, education, health, production, and transportation sectors (34).

Table 1: Most common effects of disasters on environmental health (35)

Water supply and wastewater disposal
• Damage to civil engineering structures • Broken mains • Damage to water sources • Power outages • Contamination (biological or chemical) • Transportation failures • Personnel shortages • System overload (due to population shifts) • Equipment, parts, and supply shortages
Solid waste handling
• Damage to civil engineering structures • Transportation failures • Equipment shortages • Personnel shortages • Water, soil, and air pollution
Food handling
• Spoilage of refrigerated foods • Damage to food preparation facilities • Transportation failures • Power outages • Flooding of facilities • Contamination/degradation of relief supplies
Vector control
• Proliferation of vector breeding sites • Increase in human/vector contacts • Disruption of vector-borne disease control programs
Home sanitation
• Destruction or damage to structures • Contamination of water and food • Disruption of power, heating, fuel, water, or supply waste disposal services • Overcrowding

To protect environmental health in the aftermath of disasters, it is crucial to provide basic needs such as shelter, water, food, waste management, pest control, and organizing the daily lives of disaster victims. Nonetheless, long-term and comprehensive planning is also necessary to decrease the possibility of future disasters and facilitate recovery.

Providing shelter, water, waste management, and food safety within the context of disaster response and environmental health is of immense importance, as seen below:

✓ Shelter: After a disaster, ensuring the availability of critical components of environmental health services is essential. Among these components, shelter plays a crucial role in protecting individuals from exposure to the elements and preventing the spread of disease. Providing safe and secure temporary housing can significantly reduce the risks of adverse health effects.

✓ Water: Access to safe and clean water is paramount for maintaining good health, particularly when water sources may be contaminated after a disaster. Disaster response efforts must prioritize providing clean drinking water.

✓ Waste management: Disasters can generate significant amounts of waste, including debris from destroyed buildings and hazardous materials, making proper waste management critical in preventing the spread of disease and mitigating environmental damage.

✓ Food safety: Natural disasters can have negative impacts on food supplies, resulting in food shortages and contamination that can contribute to the spread of disease. Thus, ensuring the safety of food is vital for maintaining good nutrition and preventing disease transmission.

Natural disasters can have a severe impact on the environment and public health, which is why it is crucial to maintain or quickly rehabilitate effective environmental health services in emergency health management. In providing immediate assistance, priority should be given to areas with high population densities and severe disruption of services as these areas are more likely to experience increased health risks (35).

Immediately following disasters, it is crucial to prioritize the delivery of fundamental needs, including shelter, water, food, and waste management to ensure environmental health is maintained. Following Hurricane Katrina in 2005, providing shelter for the displaced population was a pressing issue, which the Federal Emergency Management Agency tackled through the creation of temporary housing units and financial aid for home rebuilding (36).

Providing access to safe drinking water is a crucial priority in the aftermath of disasters. For example, in the aftermath of the 2010 earthquake in Haiti, the absence of clean water access led to the outbreak of waterborne diseases like cholera (37). In response, international organizations intervened by disseminating water purification tablets and building water treatment facilities (38).

Proper management of waste is a critical aspect in ensuring environmental health in the aftermath of disasters. The 2011 earthquake and tsunami in Japan generated a substantial amount of waste and debris, which posed significant health risks and environmental pollution. The Japanese government responded to this issue by implementing a comprehensive waste management plan that included sorting and recycling of debris, as well as incineration of waste in specialized facilities (39).

Effective control of rodents and insects is a crucial aspect of disaster management. After Hurricane Katrina, the accumulation of debris and garbage resulted in significant rodent infestations in the affected areas. In response, the government implemented pest control measures such as the distribution of rodent baits and the setting up of traps (40).

Disasters have diverse effects on human health, besides physical injuries. One of the significant impacts is on mental health, as affected individuals may encounter significant stress, fear, and trauma. Consequently, it is crucial to prioritize addressing mental health impacts in disaster response and recovery efforts (41).

Disasters can have profound mental health implications for individuals, families, and communities affected by them. The exposure to extreme events and disasters can generate considerable stress, leading to both short- and long-term changes in people's lives. Besides post-traumatic stress disorder, anxiety, depression, and substance abuse can also emerge. For instance, the Deepwater Horizon oil spill in the Gulf of Mexico in 2010 caused considerable psychological distress among the affected communities due to the loss of livelihoods and environmental damage (42,43).

Moreover, those with chronic diseases are particularly vulnerable during disasters, in addition to physical injuries and mental health impacts. Disruption of health services can prevent individuals with chronic diseases from accessing the ongoing medical care they require, which can lead to worse outcomes and even death (44).

Disasters can pose a particular risk to individuals with chronic diseases who may lose access to critical medication and medical aids during evacuations,

leading to deteriorated health outcomes and increased mortality risk. The 2013 Typhoon Haiyan in the Philippines highlighted this vulnerability, as many individuals with chronic diseases experienced worsened health outcomes due to a lack of access to essential resources (45,46).

A recent systematic review discovered that many patients lose access to their medication and essential medical aids such as insulin pens during evacuations, while some do not have a record of their prescriptions during emergencies, making it crucial to consider the needs of individuals with chronic diseases in disaster preparedness and response (45).

While infectious diseases are a common concern following disasters, most disaster-related deaths are caused by physical injuries such as blunt trauma or drowning, or exposure to environmental hazards such as air pollution from forest fires or building collapses, rather than infectious diseases (47). Therefore, addressing a wide range of health impacts is crucial in disaster response and recovery efforts.

Disasters can have varied effects upon environmental health, encompassing factors such as loss of life, physical harm, damage to infrastructure, and problems with water safety and availability (34). The earthquake that took place in Haiti in 2010 resulted in a significant number of casualties and injuries, while the earthquake and tsunami that occurred in Sulawesi, Indonesia in 2018 left around 152000 people with no access to safe water (37,48).

Disasters can result in extensive housing and shelter issues, as observed during the aftermath of Hurricane Katrina in 2005. Moreover, disasters can exacerbate food insecurity, as illustrated by the impact of the 2013 Typhoon Haiyan in the Philippines, where more than 3 million individuals suffered from food shortages (45,49).

Disasters can lead to extensive damage to infrastructure and urban areas, with displaced individuals often forced to relocate and rebuild. (50) As a result, environmental health is significantly impacted by disasters, affecting various aspects of human life and wellbeing.

According to projections, the occurrence of disaster events is expected to rise by 40% by the year 2030. This trend will likely have a disproportionate impact on developing countries and vulnerable communities, leading to severe consequences (51).

Apart from addressing immediate concerns, it is crucial to plan comprehensively for the long-term to minimize the risk of future disasters and ensure a return to normalcy. In response to the 2011 earthquake and tsunami

in Japan, the government implemented measures such as constructing seawalls and setting up early warning systems to enhance infrastructure and disaster preparedness (52).

International cooperation is a critical element in disaster response, particularly in developing countries, as recognized by the United Nations General Assembly in its effort to reduce the impact of natural disasters. Consequently, the international community dedicated the 1990s as the International Decade for Natural Disaster Reduction (IDNDR 1994) to prioritize cooperation in reducing natural disasters (53).

Over the course of time, endeavors in response to disasters have evolved and established frameworks and tactics to safeguard both the environment and public health. For instance, in the aftermath of the 2010 earthquake in Haiti, the World Health Organization partnered with other organizations to augment environmental health services, including but not limited to water and sanitation, waste management, and vector control, in order to mitigate the transmission of diseases. Similarly, UNICEF provided emergency supplies of water and sanitation and upgraded hygiene practices in provisional settlements to avert waterborne illnesses after the Nepal earthquake in 2015. These actions exemplify the significance of competent environmental health services in alleviating the impact of natural disasters on public health (53-55).

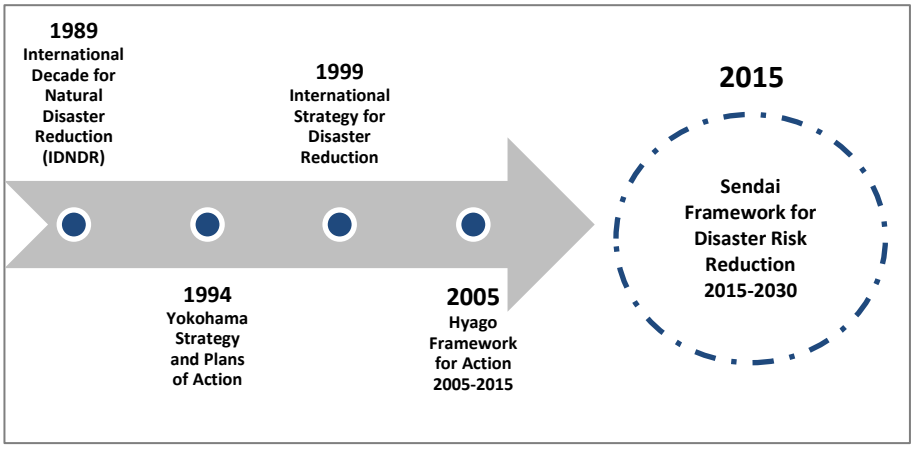


Figure 5: Twenty-five years of international commitments to disaster risk reduction (44)

The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) offers Member States specific strategies to safeguard their development achievements from potential disaster hazards and represents a crucial agreement in the post-2015 development plan. The United Nations General Assembly authorized the Sendai Framework for Disaster Risk Reduction. The Sendai Framework proposes a comprehensive approach to diminish risk and promote global resilience, encompassing a people-centered strategy to avert and mitigate new and existing disaster risks, reduce vulnerability and exposure to hazards, enhance preparedness for response and recovery, and strengthen the resilience of individuals, businesses, communities, and countries during the next decade (56).

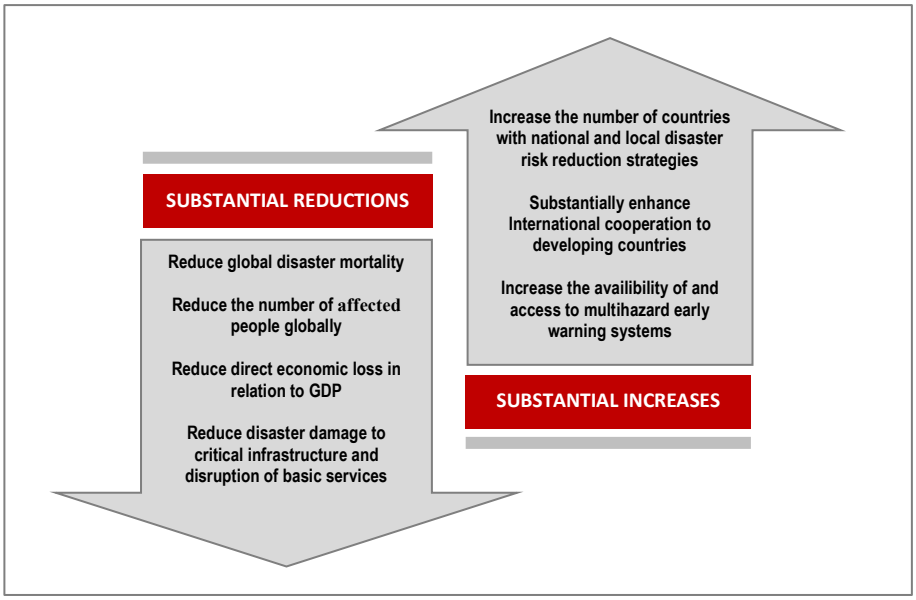


Figure 6: Sendai Framework outlines seven global targets to be achieved by 2030 (56)

Coordinated efforts at an international level are essential for delivering aid to communities impacted by natural disasters, and various initiatives have been launched to alleviate the adverse effects of calamities on individuals, particularly those residing in less developed countries.

6. Conclusion

In conclusion, the environment is a vital factor in healthcare, particularly in emergency health management following natural disasters. It is imperative to provide efficient environmental health services to safeguard individuals from exposure to the elements, prevent the transmission of diseases, and ensure adequate nutrition. According to the Pan American Health Organization, densely populated regions with severe service interruptions are at the highest risk during disasters, and these areas must be the central focus (35).

In disaster response efforts, critical components of environmental health services such as shelter, water, waste management, and food safety must be given top priority.

Reducing the probability of a natural event turning into a disaster, eliminating disaster-prone conditions, preventing secondary and tertiary disasters that may follow, and returning to the old order, as well as healing the wounds of disasters, require long-term and comprehensive thinking (57).

In summary, the provision of effective environmental health services in disaster response efforts is paramount in safeguarding the safety and welfare of affected communities. To mitigate the impact of natural disasters and promote resilience in nations and communities, it is imperative to foster international cooperation and collaboration among various sectors and organizations.

References

1. Last, J. M. A dictionary of epidemiology (4th ed.). Oxford University Press; 2001.

2. Prüss-Ustün, A., Wolf, J., Corvalán, C., Bos, R., & Neira, M. Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks. World Health Organization; 2016.

3. Akdur, R. Ekolojik Denge Çevre Kirliliği ve İnsan Sağlığı. Akdur, R., Çöl, M., Işık, A., İdil, A., Durmuşoğlu, M., & Tunçbilek, A. Halk sağlığı (s. 53-71) içinde. AÜTF Antıp AŞ Yayınları;1998.

4. Çiğdem, Ş., & Yılmaz, İ. Disaster management and public health. Journal of Public Health Nursing. 2019;6(1), 21-27.

5. McMichael, A. J. The urban environment and health in a world of increasing globalization: issues for developing countries. Bulletin of the world Health Organization, 2000;78, 1117-1126.

6. Landrigan, P. J., Fuller, R., Acosta, N. J. R., Adeyi, O., Arnold, R., Basu, N., … Zhong, M. The Lancet Commission on pollution and health. The Lancet. 2018;391(10119), 462–512.

7. Brook, R. D., Rajagopalan, S., Pope, C. A., Brook, J. R., Bhatnagar, A., Diez-Roux, A. V., ... & Kaufman, J. D. Particulate matter air pollution and cardiovascular disease: an update to the scientific statement from the American Heart Association. Circulation. 2010;121(21), 2331-2378.

8. Rajagopalan, S., & Brook, R. D. Air pollution and type 2 diabetes: mechanistic insights. Diabetes. 2012;61(12), 3037-3045.

9. Brulle, R. J., & Pellow, D. N. Environmental justice: human health and environmental inequalities. Annual review of public health. 2006;27, 103-124.

10. Gee, G. C., & Payne-Sturges, D. C. Environmental health disparities: a framework integrating psychosocial and environmental concepts. Environmental health perspectives. 2004;112(17), 1645-1653.

11. World Health Organization. Environmental health. https://www.who.int/health-topics/environmental-health#tab=tab_1. Accessed February 2023.

12. World Health Organization. Environmental health. https://www.who.int/health-topics/environmental-health#tab=tab_2. Accessed February 2023.

13. Bousquet, J., Kuh, D., Bewick, M., Standberg, T., Farrell, J., Pengelly, R., ... & Zins, M. Operational definition of active and healthy ageing (AHA): a conceptual framework. The journal of nutrition, health & aging. 2015;19, 955-960.

14. Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... & Murray, C. J. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet. 2019;393(10170), 447-492.

15. Cohen, A. J., Brauer, M., Burnett, R., Anderson, H. R., Frostad, J., Estep, K., ... & Balakrishnan, K. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. The Lancet. 2017;389(10082), 1907-1918.

16. Huang, C., Vaneckova, P., Wang, X., FitzGerald, G., Guo, Y., & Tong, S. Constraints and barriers to public health adaptation to climate change: a review of the literature. American journal of preventive medicine. 2011;40(2), 183-190.

17. FAO, UNEP, WHO, and WOAH. One Health Joint Plan of Action (2022-2026). Working together for the health of humans, animals, plants and the environment. Rome; 2022.

18. Güler, Ç. ve Vaizoğlu Acar, S. Çevre Sağlığı. Ç. Güler, & L. Akın (Ed.) Halk Sağlığı Temel Bilgiler 2 (3. Baskı, s. 540-573) içinde. Hacettepe Üniversitesi Basımevi; 2015.

19. Güler, Ç. ve Vaizoğlu Acar, S. Afetler ve Afet Tıbbı. Ç. Güler, & L. Akın (Ed.) Halk Sağlığı Temel Bilgiler 2 (3. Baskı, s. 1106-1131) içinde. Hacettepe Üniversitesi Basımevi; 2015.

20. United Nations Office for Disaster Risk Reduction. (n.d.). Terminology. https://www.undrr.org/terminology. Accessed February 2023.

21. Centre for Research on the Epidemiology of Disasters and United Nations Office for Disaster Risk Reduction. The human cost of disasters: an overview of the last 20 years (2000-2019) https://www.preventionweb.net/files/74124_humancostofdisasters20002019reportu.pdf?_gl=1*6r824v*_ga*NjU0NjQzMzA2LjE2Nzk0OTgzMTc.*_ga_D8G5WXP6YM*MTY3OTU1NjUzNS4yLjEuMTY3OTU1NjU5Ny4wLjAuMA. Accessed February 2023.

22. United Nations Office for Disaster Risk Reduction. Sendai framework for disaster risk reduction 2015-2030. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030. Accessed February 2023.

23. Akdur, R. Afetlere Hazırlık ve Afet Yönetimi. S. Esin, T. Oğuzhan, KC. Kaya, T. Ergüder, AT. Özkan ve İ. Yüksel (Ed.), Afetlerde Sağlık Hizmetleri Yönetimi (s. 1-61) içinde. Ankara: T.C. Sağlık Bakanlığı Sağlık Projesi Genel Koordinatörlüğü; 2001.

24. Güler, Ç. ve Çobanoğlu, Z. Afetlerde Çevre Sağlığı Önlemleri, Çevre Sağlığı Temel Kaynak Dizisi: 39. Ankara: T.C. Sağlık Bakanlığı Sağlık Projesi Genel Koordinatörlüğü; 1997.

25. Fuse, A., & Yokota, H. Lessons learned from the Japan earthquake and tsunami, 2011. Journal of Nippon Medical School. 2012;79(4), 312-315.

26. Lal, P., Prakash, A., Kumar, A., Srivastava, P. K., Saikia, P., Pandey, A. C., ... & Khan, M. L. Evaluating the 2018 extreme flood hazard events in Kerala, India. Remote Sensing Letters. 2020;11(5), 436-445.

27. Varma, R., & Varma, D. R. The Bhopal disaster of 1984. Bulletin of Science, Technology & Society. 2005;25(1), 37-45.

28. Beyer, J., Trannum, H. C., Bakke, T., Hodson, P. V., & Collier, T. K. Environmental effects of the Deepwater Horizon oil spill: a review. Marine pollution bulletin. 2016;110(1), 28-51.

29. Aon. Weather, Climate & Catastrophe Insight: 2022 Annual Report. https://thoughtleadership.aon.com/documents/20220308_aon_wccir_2022_annual_report.pdf. Accessed February 2023.

30. Benli, H., & Bacanlı, M. Türkiye'de Afet Yönetimi ve Doğa Kaynaklı Afet İstatistikleri. Afet ve Acil Durum Yönetimi Başkanlığı, Ankara; 2016.

31. Ersoy, Ş., & Koçak, A. Disasters and earthquake preparedness of children and schools in Istanbul, Turkey. Geomatics, Natural Hazards and Risk, 7(4), 1307-1336.

32. Middle East Technical University. Preliminary Reconnaissance Report on February 6, 2023 Kahramanmaraş-Pazarcık (Mw=7.7) and Elbistan (Mw=7.6) Earthquakes https://eerc.metu.edu.tr/en/system/files/documents/DMAM_Report_2023_Kahramanmaras-Pazarcik_and_Elbistan_Earthquakes_Report_final_ENG.pdf. Accessed March 2023.

33. United Nations News. More than one disaster a day looming without action on risk reduction, UN warns https://news.un.org/en/story/2022/04/1117022. Accessed March 2023.

34. Güler, Ç. ve Çobanoğlu, Z. Afetler, Çevre Sağlığı Temel Kaynak Dizisi: 33. Ankara: T.C. Sağlık Bakanlığı Sağlık Projesi Genel Koordinatörlüğü; 1994.

35. Pan American Health Organization. Environmental Health in Emergencies and Disasters: A Practical Guide. Washington, DC: Pan American Health Organization; 2000.

36. The Federal Emergency Management Agency. Hurricane Katrina Response and Recovery Update. https://www.fema.gov/press-release/20210506/hurricane-katrina-response-and-recovery-update. Accessed March 2023.

37. Centers for Disease Control and Prevention. Cholera in Haiti. https://www.cdc.gov/cholera/haiti/index.html. Accessed March 2023.

38. Patrick, M., Berendes, D., Murphy, J., Bertrand, F., Husain, F., & Handzel, T. Access to safe water in rural Artibonite, Haiti 16 months after the onset of the cholera epidemic. The American journal of tropical medicine and hygiene. 2013;89(4), 647.

39. Kawamoto, K., & Kim, K. Social capital and efficiency of earthquake waste management in Japan. International Journal of Disaster Risk Reduction. 2016;18, 256-266.

40. Goddard, J., & Varnado, W. C. Disaster vector control in Mississippi after Hurricane Katrina: Lessons learned. Journal of the American Mosquito Control Association. 2020;36(2s), 56-60.

41. Williams, R., & Drury, J. Psychosocial resilience and its influence on managing mass emergencies and disasters. Psychiatry. 2009;8(8), 293-296.

42. Neria, Y., Nandi, A., & Galea, S. Post-traumatic stress disorder following disasters: a systematic review. Psychological medicine. 2008;38(4), 467-480.

43. Drescher, C. F., Schulenberg, S. E., & Smith, C. V. The Deepwater Horizon Oil Spill and the Mississippi Gulf Coast: Mental health in the context of a technological disaster. American Journal of Orthopsychiatry. 2014;84(2), 142.

44. Aitsi-Selmi, A., Egawa, S., Sasaki, H., Wannous, C., & Murray, V. The Sendai framework for disaster risk reduction: Renewing the global commitment to people's resilience, health, and well-being. International journal of disaster risk science. 2015;6, 164-176.

45. Ochi, S., Hodgson, S., Landeg, O., Mayner, L., & Murray, V. Disaster-driven evacuation and medication loss: a systematic literature review. PLoS currents. 2014;6.

46. Chiu, Y. T. Typhoon Haiyan: Philippines faces long road to recovery. The Lancet. 2013;382(9906), 1691-1692.

47. Malilay, J., Heumann, M., Perrotta, D., Wolkin, A. F., Schnall, A. H., Podgornik, M. N., ... & Zane, D. F. The role of applied epidemiology methods in the disaster management cycle. American Journal of Public Health. 2014;104(11), 2092-2102.

48. The United Nations Children's Fund. Sulawesi Earthquake & Tsunami: One month on from the disaster, thousands of children still homeless, out-of-school and in need of humanitarian support. https://www.unicef.org/press-releases/sulawesi-earthquake-tsunami-one-month-disaster-thousands-children-still-homeless-out. Accessed March 2023.

49. World Food Programme. Philippines: A Year After Typhoon Haiyan. https://www.wfp.org/videos/philippines-year-after-typhoon-haiyan. Accessed March 2023.

50. Ingram, J. C., Franco, G., Rumbaitis-del Rio, C., & Khazai, B. Post-disaster recovery dilemmas: challenges in balancing short-term and long-term needs for vulnerability reduction. Environmental science & policy. 2006;9(7-8), 607-613.

51. United Nations Office for The Coordination of Humanitarian Affairs. OCHA's Strategic Plan 2023-2026: Transforming Humanitarian Coordination. Available:https://www.unocha.org/sites/unocha/files/OCHA%27s%20Strategic%20Plan%202023-2026.pdf. Accessed March 2023.

52. Koshimura, S., & Shuto, N. Response to the 2011 great East Japan earthquake and tsunami disaster. Philosophical Transactions of the Royal

Society A: Mathematical, Physical and Engineering Sciences. 2015;373(2053), 20140373.

53. United Nations Office for Disaster Risk Reduction. The Early Engagement of the United Nations in Disaster Risk Reduction (1970-2000): a brief history. Geneva; 2022. https://www.undrr.org/media/78789/download. Accessed March 2023.

54. Pan American Health Organization. Health response to the earthquake in Haiti January 2010. https://iris.paho.org/bitstream/handle/10665.2/52841/9789275132524_eng.pdf?sequence=1&isAllowed=y. Accessed March 2023.

55. The United Nations Children's Fund. UNICEF in Nepal: A five-decade partnership. https://www.unicef.org/nepal/about-us#:~:text=Supporting%20early%20childhood%20care%20and,in%20the%20most%20remote%20locations.

56. United Nations Office for Disaster Risk Reduction. What is the Sendai Framework for Disaster Risk Reduction? Available: https://www.undrr.org/implementing-sendai-framework/what-sendai-framework. Accessed March 2023.

57. Çakmak, H., Ocaktan, M. E. & Akdur, R. Doğal afetler, eşitsizlikler ve sağlık sonuçları. A. Akın (Ed.) Eşitsizlikler ve Sağlık Sonuçları (1. Baskı, s. 88-94) içinde. Ankara: Türkiye Klinikleri; 2018.

CHAPTER V

EFFECTS OF GLOBAL CLIMATE CHANGE ON HEALTH

Esin BAŞARAN

(Asst. Prof. Dr.) Başkent University, Vocational School of Health Services
e-mail: ebasaran@baskent.edu.tr
ORCID: 0000-0002-6193-3395

1. Introduction

Climate change occurs as a result of changing the composition of the atmosphere directly or indirectly due to human activities, in addition to the natural variability of the climate.

Global climate change is a major problem that has led to a gradual increase in the average annual temperature of the planet, which began with the industrial revolution in the early 20th century (1). Since the mid-20th century, human activities have contributed more than 95% to current significant climate change and warming trends (2). The climate, which has changed significantly under the influence of human behavior, is due to the change in the proportionality and concentration of greenhouse gases such as water vapor, carbon dioxide, ozone, methane, PFC (perfluorocarbons) in the atmosphere (3).

The greenhouse effect is the warming of the lower layers of the atmosphere as a result of the accumulation of greenhouse gases. This results in an increase in temperature at the earth's surface. As a result, the air temperature becomes higher than it should be. This leads to irreversible consequences such as climate change and global warming (4). Global warming is the increase in average temperatures measured on sea, land and air on Earth throughout the year (5).

The use of coal, oil, natural gas, which emits large amounts of carbon dioxide and other harmful compounds into the atmosphere when burned, the use of combustible minerals in industries, the use of transportation vehicles that emit exhaust fumes that pollute the air and deforestation can be shown among the causes of the greenhouse effect. Population growth affects the need for

food, clothing and shelter. In order to meet this need, the increase in industrial production, the use of large amounts of chemicals and fertilizers in agriculture, the decomposition and burning of garbage in landfills contribute to a further increase in greenhouse gases in the atmosphere (6,7).

With the increase in industrialization in the world, the energy needed is mostly obtained from the burning of fossil fuels. Combustion of these fuels causes a large amount of CO_2 and other greenhouse gases to be emitted into the atmosphere. Under normal conditions, the rays from the sun heat the earth and are reflected in the atmosphere. These gases cause some of these reflected rays to be kept in the atmosphere. This causes the average earth surface temperature to rise (8).

The most important anthropogenic greenhouse gas is carbon dioxide (CO_2). Approximately 75% of the anthropogenic CO_2 emissions released into the atmosphere in the last 20 years resulted from the use of fossil fuels (9). From 1997 to 2016, global average carbon dioxide emissions from forest fires equated to about 22% of carbon emissions from burning fossil fuels (10). Forest loss due to wildfires in tropical regions harms the Earth's ability to absorb carbon dioxide and cool the climate (11).

Increasing temperatures, which is one of the consequences of climate change, cause an increase in the temperatures felt together with the intense construction in the cities and increases the negative effects of disease on human health. Huge buildings are the reason for the sweltering heat in big cities. The decrease in green areas due to overpopulation and the increase in construction in the form of skyscrapers increase the perceived temperature by 3 ^{o}C. The heat island formed between the buildings cuts the wind of the city and the reflection of the sun rays on the glass covered surfaces causes an increase in temperature (12).

There has been a gradual increase in monthly average temperatures over the last 200 years and this has increased significantly in recent times. The period from 1951 to 1980 saw an increase in global temperatures. Melting polar ice caps and changing precipitation patterns may have contributed to rising sea levels (13,14). Between 1902 and 2015, the global mean sea level rose by 0.12–0.21 m (15). If sea level rise is not reduced, it is estimated that within 80 years it will rise 2m above current levels. It is predicted to be even higher in some places, given the collapse of the ice sheet, waves, tidal contributions and other factors (16-19).

Sea level rise poses direct and indirect risks to health. It is therefore a very important issue for the Indian and Pacific Oceans, the Caribbean, and many

small low-lying island states and low-lying (continental) coastal populations and river delta regions. A rise of one meter would flood an area of Bangladesh currently inhabited by about 40% of its total population. It will displace more than 20 million people along the vulnerable coastal areas of Bangladesh, Egypt and Nigeria (20, 21).

Direct risks include physical hazards from coastal flooding, more extensive flooding and increasingly severe storm surges. All damage to coastal infrastructure (roads, shelter and sanitation systems) will pose a direct risk to health.

Indirect risks to health include salinization of freshwater resources (22), loss of productive farmland, and changes in breeding habitats for coastal mosquitoes. Sea level rise is already endangering freshwater resources, food yields and physical security in some small low-lying island states (23,24).

2. Health Risks Due to Climate Change

Climate change is one of the greatest threats to human health in the 21st century. Climate affects health in myriad ways, including temperature rise, sea level rise, air pollution, deterioration of food systems, increased water and vector-borne diseases, and mental health problems. Climate also affects infectious diseases (25,26).

The pace of global warming has accelerated in the last 50 years. 2014 and 2015 were the world's hottest years on record. It is believed that increasing ambient temperatures change precipitation patterns and cause extreme weather conditions. Increase in temperature can have direct and indirect effects on human health (27).

Air pollutants directly affect health. Greenhouse gases affect health by causing climate change (28).

Climate causes an increase in soil-borne, water-borne, food-borne and vector-borne infectious diseases (29).

About 250,000 additional deaths per year are expected between 2030 and 2050 from malnutrition, diarrhea, malaria and heat stress caused by climate change (27).

Women, children, ethnic minorities, poor communities, immigrants or displaced persons, the elderly and those with underlying health problems are more affected by climate-sensitive health risks (26).

It is possible to collect the health problems caused by global climate change under eight groups.

2.1 Injury and Mortality from Extreme Weather Events

Climate change can alter the frequency, timing, intensity and duration of extreme weather events. There has been an increase in heavy rainfall in the last century. According to future climate scenarios, there will be increases in the frequency of extreme precipitation events, which will increase the risk of flooding. Injury and death are direct health effects often associated with natural disasters (30).

Climate change is increasing the duration, intensity and frequency of drought events. These changes pose threats to water security, sanitation and food productivity. It also increases the risk of forest fires and exposure of the environment to pollutants (31).

Rising temperatures, heat waves, floods, hurricanes, droughts, fire, deforestation, melting of glaciers, disappearance of rivers, desertification can directly and indirectly cause physical and mental human pathologies (32).

Children may be more vulnerable to the psychological complications of extreme weather events linked to climate change. After two floods in Europe in 1990, children showed signs of moderate to severe stress and long-term post-traumatic stress disorder, depression, and dissatisfaction with life ahead (33).

Heat waves, cold waves, droughts, heavy rain and snowfall, floods, and hurricanes are extreme weather events. More than 530,000 people lost their lives in approximately 15,000 extreme weather events in the 20 years from 1993 to 2012 around the World (34).

2.2 Heat-related Ilness

Climate change is causing a global increase in average temperatures and increasing the intensity, duration and frequency of extreme heat events. It causes unprecedented levels of heat exposure. The past 7 years have been the hottest on record (35). Frequent extreme heat events are expected in the coming years as temperatures rise above 2°C compared to pre-industrial times by the middle of the century (36). It is estimated that heat waves that used to be once every 10 years will increase by more than 5 times, and events that used to be once every 50 years will occur almost 14 times more often (2). Rising global temperatures and heatwaves are already increasing the global health burden and causing significant economic losses (35).

Exposure to high temperatures can cause heat-related illnesses such as heat exhaustion, heat cramps, heat stroke and death (37). The most common heat-

related illness is heat exhaustion. If not recognized and treated, these mild to moderate signs and symptoms can progress to heat stroke (38). Heatstroke is a serious illness with a core body temperature above 40°C and accompanied by central nervous system abnormalities (39). Heat stroke is a medical emergency that requires prompt recognition and treatment to prevent lasting complications and death. The death rate from classic heatstroke approaches 80% and 33% in the absence of emergency treatment for exertional heatstroke (40,41).

Studies have found that heat-related illnesses such as heatstroke, heat exhaustion, hyperthermia, and diseases that occur during extreme heat events such as acute kidney failure and cardiovascular disease correspond to increased hospital/emergency room visits during heat waves (42,43). In addition, significant increases in hospital visits were seen for fatigue (44), electrolyte imbalance, nephritic syndrome, and diabetes (45).

Heat waves kill people primarily by causing myocardial infarction, stroke, respiratory failure and heat stroke. The heatwave in Western Europe in August 2003 caused an estimated 40,000–50,000 deaths, particularly in older people and people of any age group with lung conditions and cardiovascular diseases (46,47).

Ozone, an important urban air pollutant, forms more readily at higher temperatures than air pollutant precursors from car exhausts. Much of the huge excess of mortality in Western Europe caused by the August 2003 heat wave may be due to high ozone levels coexisting in and around some major cities (48,49).

High temperatures can reduce the frequency of physical activity, duration of physical activity and the desire to exercise (50-52). Even low amounts of physical activity at high temperatures can pose a health risk (53).

During pregnancy, exposure to heat waves can result in lower birth weight. It may also increase the incidence of preterm birth (54).

Increasing ambient temperatures will likely increase rates of aggressive and criminal behavior, resulting in increased rates of physical assault and murder (55). This may lead to higher rates of suicide, particularly among men and older adults (56,57).

Heat suppresses thyroid hormones, causing functional hypothyroidism. (58) Body dehydration that occurs with heat stress can cause significant impairments in cognitive functioning (59).

Exposure to heat has been associated with deaths from non-accidental and cardiovascular and respiratory diseases (60-62).

A warming climate is predicted to increase the overall death rate from non-accidental heat in developed countries in the future (63-69).

The most susceptible to adverse health risks from exposure to extreme heat are the elderly, people living alone and those who do not have access to air conditioning (70). In addition, people with a chronic mental disorder or pre-existing cardiovascular disease, obesity, neurological or psychiatric disease, and those who use salt and water imbalance medications are at greater risk for heat-related illness and death. Drinking alcoholic beverages, consuming narcotics, and participating in strenuous physical activities outdoors in hot weather are also risky behaviors associated with heat-related illnesses (39,70-72).

Children and the elderly peole are particularly susceptible to the health risks of high temperatures and heat waves.

More than a third of heat-related deaths during the global hot season can be attributed to climate change (73).

The ratio of children's body mass to surface area is small. They are more susceptible to dehydration. This makes them more vulnerable to heat-related morbidity and mortality.

For a 10 degree increase in mean daily apparent temperature, the infant mortality rate increased by 4.9% and the mortality rate of children under five increased by 4.2% (74).

A study of warm-season mortality with children under 5 years old and infants under 1 year found that higher mortality rates were experienced with increasing daily temperatures in California (75).

There has been a 54% increase in heat-related deaths among people over the age of 65 in the last 20 years (76).

Extreme heat events, or heat waves, are the leading cause of weather-related human deaths in the United States, causing more deaths each year than hurricanes, lightning, floods, and earthquakes combined. All heat-related illnesses and deaths are preventable. Despite this, many people succumb to extreme heat every year. In a 5-year period from 1999 to 2003, a total of 3442 heat-related deaths were reported in the United States (average of 688 per year) (77).

2.3 Respiratory Ilness

Climate change poses a threat to respiratory health by directly promoting or exacerbating respiratory diseases or by increasing exposure to risk factors for respiratory diseases. It increases the amount of pollen and allergens produced by

each plant, mold growth, and external ozone and particulate matter concentrations at ground level. Diseases of major concern are rhinosinusitis, asthma, chronic obstructive pulmonary disease and respiratory tract infections (78).

Worsening air quality and increasing allergens as a result of climate change can worsen the existing disease. Climate-related changes in allergens and infection vectors can cause new diseases (79).

Increasing temperatures as a result of climate change increase the amount of air pollutants. For example, levels of other air pollutants such as particulate matter and ozone, which exacerbate respiratory diseases and cardiovascular reported to increase at high temperatures (80). Increased ozone concentrations have been shown to be associated with decreased respiratory function and chronic respiratory diseases and allergic respiratory diseases (81). There are many studies investigating the relationship of air pollutants such as ozone carbon monoxide, nitrogen oxides, lead, particulate matter and sulfur dioxide with asthma and other chronic lung diseases. The combination of high temperature and physical exertion with additional heat load increases respiratory frequency and thus may increase total air pollutant uptake (82,83).

Exposure to air pollutants is associated with respiratory infections such as pneumonia or bronchiolitis. Ambient air pollution has increased hospital admissions due to lower respiratory tract infections (84).

Exposure to increased atmospheric O_3 levels results in decreased lung function and increased airway reactivity to bronchoconstrictor agents. It is associated with an increased risk of asthma exacerbations in patients with asthma (85,86). Epidemiological studies have provided evidence that asthma attacks increase and hospital admissions due to respiratory diseases increase with the increase in ozone concentration in the environment (85,87-89). Some studies have stated that ozone increases asthma morbidity by increasing airway inflammation and epithelial permeability (87,88,90).

High ozone concentrations cause major obstructive pulmonary disease and pneumonia. This condition was associated with bronchial inflammation, exacerbation of chronic obstructive pulmonary disease (91).

Higher temperatures from climate change are affecting aeroallergenic plant pollen production worldwide (92). Increasing carbon dioxide amounts and higher temperatures cause increased growth of allergenic plants (93). Both increased growth and longer pollen seasons with warmer springs and delays in the first fall frost can result in increased pollen production (94-96).

Longer pollen seasons (and increased pollen concentrations in ambient air) prolong human exposure to aeroallergens, thereby increasing allergic sensitivity. Exposure to more and more allergenic pollen can cause people who are not currently allergic to develop allergic symptoms. It has the potential to increase the severity and duration of symptoms in people with allergic disease (97-99).

CO_2 and temperature increase cause plants to flower earlier and scatter more pollen than expected. This situation is of great importance in terms of the prevalence of allergic rhinitis/asthma in cities (100). There have been increases in hospitalizations, doctor visits, and sales of over-the-counter allergy medications for asthma and allergic rhinitis (101-103).

The range, volume and seasonality of pollens and spores are also affected by temperature, precipitation and humidity. Associated increases in the incidence of hay fever and asthma have been reported in some urban populations (104).

Climate change can affect the incidence of viral, bacterial, fungal and tick-borne respiratory infections (105).

Changes in temperature, precipitation, relative humidity, and air pollution affect viral activity and transmission. It increases the size and severity of epidemics (106).

Climate change increases the inhalation exposure of soil, increasing fungal infections. For example, outbreak of Coccidioidomycosis was occurred in California (107).

A second climatic mechanism that increases the incidence of fungal disease in the respiratory system is flooding. Overflow of normally dry soil and shelter materials causes fungal overgrowth leading to fungal and polymicrobial infections. There are epidemiological studies documenting the increased incidence of respiratory tract infections after floods (108,109).

In one study, researchers found that 13% of all deaths after the floods in Bangladesh in 1988 were caused by respiratory infections. Acute respiratory infections were responsible for about half of the deaths (110). If climate change results in more flooding, acute respiratory infections may increase.

Changes in temperature have an impact on the incidence and mortality of respiratory tract infections. Especially vulnerable to daily temperature fluctuations are older adults and children (111). An Australian study showed that sharp temperature drops between consecutive days caused an increase in hospital admissions with childhood pneumonia (112).

Babies and children are susceptible to air pollution because their organs are developing and they have higher air per body weight gain. The health effects of

air pollution cause exacerbation of respiratory diseases. It also causes decreased lung function improvement and increases incidence of asthma (113).

Children's respiratory rates increasing according to their body size, spending more time outside and developing respiratory tracts increase their sensitivity to the harms caused by ozone air pollution (114).

The elderly people are more susceptible to the effects of ambient air pollution. Studies were found a correlation between hospital admissions in elderly patients for pneumonia (115,116) and asthma (117), and levels of air pollutants.

The study of 345 hospitalized patients showed an association between hospitalizations for pneumonia in patients older than 65 years who were exposed to high levels of air pollution for a long time (118).

Increase in pollutants (PM 10, SO_2 and CO) in Sao Paulo, Brazil was increased the number of chronic obstructive pulmonary disease admissions, especially in the elderly (119). In this study, women were found to be sensitive to elevations in CO levels.

One study found that people over the age of 65 experienced a 1.1% increase in mortality for every 10 ppb increase in the 8-hour average ozone concentration per day (120).

2.4 Water-borne Diseases

Waterborne human pathogens can take a variety of routes, from water intake to transmission via insect vectors. Waterborne pathogens are greatly affected by climate and environmental conditions. Therefore, climate change may affect the infectious disease burden caused by these pathogens. Climatic factors determine the number, virulence, type and infectivity of waterborne pathogens or aquatic vectors. Therefore, it can be effective on emerging infectious diseases (121).

Increased rainfall, flooding and extreme events can cause waterborne pathogens to flow into water sources. Waterborne diseases are transmitted to humans mostly through drinking, food processing, and recreational use of contaminated water.

Anthropogenic climate change has led to an increase in the number of hot days, drought and heavy precipitation events (122). Elevated temperatures can affect the virulence, replication and survival of pathogens. Heavy rainfall events can cause pathogens to become active. Drought can cause pathogens to concentrate in limited water resources (123).

Floods increase the effects of pathogens in surface waters. The study observed waterborne outbreaks after flooding events in Italy. Identified waterborne infectious diseases were *Legionellosis, Salmonellosis, Hepatitis* A, *cutaneous, Leptospirosis* visceral *Leishmaniasis,* and infectious diarrhea (124).

Different pathogens such as bacteria, viruses, protozoa and helminths can cause waterborne diseases. These pathogens can cause symptoms such as fever, diarrhea and different types of damage to the body. Diarrhea diseases are waterborne diseases and constitute an important part of the global disease burden (125,126).

Insufficient or unsafe water facilitates the transmission of diarrheal disease. Therefore, climate change may alter the distribution and incidence of diarrheal diseases.

Diarrheal diseases are the second leading cause of death in children under the age of five worldwide. It is also the second largest source of death and disability in low- and middle-income countries (125,127,128).

2.5 Vector-borne Diseases

Vector-borne diseases contribute significantly to the global disease burden. It causes epidemics that impair health security and have wider socioeconomic impacts worldwide (129).

Infectious vector-borne diseases are transmitted primarily by arthropod vectors that are sensitive to climate change. Arthropods are ectothermic. Their internal temperatures are regulated by external environmental conditions (130).

Vector-borne diseases are transmitted by infected arthropod species such as ticks, mosquitoes, triatomine bugs, midges and houseflies. Because arthropod vectors are ectothermic, temperature affects vector distribution, abundance, habitat suitability, density, and temporal pattern (eg, bite rates). It also affects the growth, survival and reproduction rates of pathogens within vectors (131).

Climate change will change the geographical distribution of animal species. Habitat change, and thus ecosystem change, combined with increased anthropogenic pressure on the natural environment, severely impacts biodiversity (132).

Zoonoses are infections that are transmitted between humans and vertebrate animals (133). Zoonoses can be transmitted from an infected vertebrate host to humans through direct contact or indirect contact with vectors (134).

The effects of global warming and geoclimatic changes on zoonotic disease epidemiology are determined by host, vector and pathogen dynamics and changes in their interactions (135).

The increasing number of interactions at the animal-human interface is mainly affecting the emergence and spread of zoonoses worldwide (136). Currently, 61% of emerging infectious diseases are zoonotic (137).

Mosquitoes can carry a variety of pathogens, including viruses, protozoan parasites and bacteria. They are responsible for the spread and transmission of many zoonotic diseases such as Zika, dengue fever and chikungunya. Appropriate temperatures affect mosquito reproduction, activity, frequency of blood meals and faster digestion (131). High water temperature causes mosquito larvae to develop rapidly. Therefore, climate changes alter mosquito-borne disease dynamics, altering vector capacity and transmission of many diseases (138).

Increased temperature affects egg production, population density, development cycle, distribution of ticks and survival rates of ticks through the winter. If the temperature rises, ticks can survive at higher latitudes and altitudes.

They described a potentially significant expansion of tick populations as far as northern Canada with a 213% increase in suitable habitat by the 2080s with a climate suitability model of *Ixodes scapularis* (139).

Other vectors responsible for the transmission of zoonotic diseases are houseflies, mites, triatomine bugs and tsetse flies. Many studies have documented a positive relationship between diseases transmitted by these vectors and climatic factors such as temperature, duration of sunlight, precipitation and humidity (140, 141).

2.6 Malnutrition and Food-borne Diseases

Rising temperatures shorten the time it takes for crops to reach maturity. Therefore, it leads to a decrease in seed yield potential (142).

Average sea surface temperature increased in the territorial waters of 95 (70%) of the 136 countries studied in 2018-20 compared to 2003-05, threatening seafood productivity. Fish consumption based on sea fishing has also decreased since 1988. There has been an increase in the consumption of farm-sourced fish products with low nutritional quality and omega-3 content (143).

The Food and Agriculture Organization estimated that more than one billion people were undernourished in 2009 (144). This number has increased by about a fifth since the late 1990s.

Food production systems are affected by water scarcity, soil depletion, biodiversity losses and climate change. Increasing temperatures and decreasing soil moisture affect photosynthesis. A study done in the Philippines shows that a 1°C increase in night temperature can reduce rice yield by 10% (145). Lobell and Asner showed that soybean and corn yields in the US fell by 17% for every degree increase in growing season temperature (146). Another study suggested that half the world's population could face severe food shortages by the end of the century, as rising temperatures are damaging farmers' crops. In tropical and subtropical regions, the harvest of crops such as maize and rice can drop between 20% and 40% due to rising temperatures during the growing season (147).

Climate change is affecting crops, forestry, livestock, fisheries, aquaculture and water systems. Therefore, hunger, disease and death due to malnutrition are expected to worsen (148).

Climate change threatens human health with its impact on malnutrition and food insecurity (149). It is estimated that malnutrition, low birth weights and inadequate breastfeeding cause 3.5 million maternal and infant deaths each year (150). In addition, one in three children born in developing countries suffer from stunting due to chronic malnutrition.

2.7 Noncommunicable Diseases

As the Earth's surface temperature rises due to changes in climate as a result of anthropogenic effects, severe heat waves, droughts, storms and floods will increase and become more severe. These changes will likely exacerbate the incidence of certain noncommunicable diseases, including cardiovascular disease, certain cancers, respiratory diseases, mental disorders, injuries and malnutrition (151).

Climate change can increase the risk of cardiovascular disease (CVD), directly through air pollution and extreme temperatures, and indirectly through changes in dietary choices. Various environmental air pollutants, including carbon monoxide, nitrogen oxides, sulfur dioxide, ozone, lead and particulate matter, are associated with increased hospitalization and cardiovascular disease-related mortality (152).

Heat-related mortality and morbidity results from overloading of the cardiovascular and respiratory systems (153).

Due to climate change changing the distribution of clouds, the level of UV radiation reaching the earth may change (5). Especially eyes and skin are target organs for UV.

The incidence of eye diseases such as cortical cataracts, conjunctival neoplasms and ocular melanoma (154), skin cancers such as basal cell carcinoma, squamous cell carcinoma and malignant melanoma (155) increases with increasing UV exposure.

The most common non-communicable diseases, such as heart disease, stroke, type 2 diabetes, respiratory diseases and cancer, caused 60% of the 58 million deaths in the world in 2004 (156).

2.8 Mental and Psychosocial Diseases

Extreme increases in temperatures associated with climate change pose a variety of risks to mental health worldwide, from changing emotional states to increased mental health hospital admissions and suicide (157-160).

The mental health consequences of climate change range from minimal symptoms of stress and distress to clinical disorders, anxiety and sleep disturbances to depression, post-traumatic stress, and suicidal thoughts (161,162).

Exposure to natural disasters due to climate and weather conditions can lead to mental health consequences such as anxiety, depression and post-traumatic stress disorder. A significant proportion of people affected by these events develop chronic psychological dysfunction. Children, pregnant and postpartum women, people with pre-existing mental illness, the economically disadvantaged, the homeless and disaster first responders are at high risk for mental health outcomes. Overheating increases both mental health and physical problems in people with mental illness. It increases risk of illness and death (163). However, there is a serious lack of psychiatric studies on climate change-related mental disorders (32).

Exposure to natural disasters caused by climate change causes stress and serious mental health problems for many people. Natural disasters will likely occur more frequently due to climate change.

There are studies investigating the effects of extreme weather events such as floods, hurricanes, forest fires, and natural disasters on mental health. The results of the study showed that people had anxiety and mood disorders, acute stress reactions, sleep disorders, and an increase in suicidal tendencies. In addition, studies have shown that people have a decrease in their sense of self and identity. These results can last for months or even years (160,164-167).

Obradovich et al. examined the relationship between historical climatic conditions and mental health in two million randomly selected US residents between 2002 and 2012. They cocluded that rising monthly temperatures from

25-30°C to over 30°C increased the likelihood of illness. They concluded that a 1°C increase in five-year warming was associated with a 2% increase in the prevalence of mental health problems (160).

3. Conclusion

In recent years, the burning of fossil fuels, deforestation, rapid population growth and the increase in consumption trends in societies have caused an increase in greenhouse gases in the atmosphere. These gases accumulated in the atmosphere absorb the low-temperature rays reflected from the earth and prevent them from returning to space. The absorption of the reflected rays by these gases in the atmosphere causes the atmospheric temperature to increase.

The effects of climate change, which occurs as a result of temperature increases, on health are multidimensional. Climate change may affect the quality of life of people and may result in their premature death. Unless action is taken, the health effects of climate change will worsen in the coming years. The awareness of the society on global climate change should be increased. Especially, this awareness of children and young people can be increased by giving wide coverage to the subject in the education at school. It is important to take individual and social measures to prevent the spread of the factors that cause global climate change on the world, and to develop policies to reduce greenhouse gas emissions such as transportation, food and energy use, and especially to prevent air pollution.

References

1) Albergel C, Calvet JC, Gibelin AL, Lafont S, Roujean JL, Berne C. Observed and modelled ecosystem respiration and gross primary production of a grassland in southwestern France. Biogeosciences. 2010; 7(5): 1657-1668.

2) Arias P, Bellouin N, Coppola E, et al. Climate change 2021: the physical science basis. Intergovernmental Panel on Climate Change, 2021 (https://www.ipcc.ch/report/ar6/wg1/. opens in new tab).

3) Mikhaylov, Alexey, et al. “Global climate change and greenhouse effect.” Entrepreneurship and Sustainability Issues 7.4, 2020; 2897.

4) Huang SK, Kuo L, Chou KL. The applicability of marginal abatement cost approach: A comprehensive review. Journal of Cleaner Production. 2016;127: 59-71.

5) Schulte PA, Chun H. Climate change and occupational safety and health: establishing a preliminary framework. Journal of occupational and environmental hygiene. 2009;6(9):542-54.

6) Levin I. Earth science: The balance of the carbon budget. Nature. 2012;488(7409): 35-36.

7) Lisin, A. Biofuel Energy in the Post-oil Era. International Journal of Energy Economics and Policy. 2020;10(2): 194-199.

8) Kawakami Y, Tagami T, Kusakabe T, Kido N, Kawaguchi T, Omura M, Tosa R. Disseminated aspergillosis associated with tsunami lung. Respir Care. 2012;57:1674–1678.

9) Solomon S, Qin D, Manning Met al. Technical summary. Contribution of working group I to the fourthassessment report of the intergovernmental panel on climatechange. Cambridge, UK: Cambridge University Press, 2007.

10) Bowman DMJS, Kolden CA, Abatzoglou JT, Johnston FH, van der Werf GR, Flannigan M. Vegetation fires in the Anthropocene. Nat Rev Earth Environ 2020;1:500-515.

11) Brando PM, Soares-Filho B, Rodrigues L, et al. The gathering firestorm in southern Amazonia. Sci Adv. 2020;6(2):1632.

12) Bernard-Verdier, Maud, et al. "Grassland allergenicity increases with urbanisation and plant invasions." Ambio 51.11. 2022;2261-2277.

13) Alley RB, Clark PU, Huybrechts P, Joughin I. Ice-sheet and sea-level changes. Science 2005;310:456–460.

14) Overpeck JT, Otto-Bliesner BL, Miller GH, Muhs DR, Alley RB, Kiehl JT. Paleoclimatic evidence for future ice-sheet instability and rapid sealevel rise. Science 2006;311:1747–1750.

15) Pörtner H, Roberts D, Masson-Delmotte V, et al. IPCC Special Report on the ocean and cryosphere in a changing climate. Geneva: Intergovernmental Panel on Climate Change, 2019.

16) Le Bars D, Drijfhout S, de Vries H. A high-end sea level rise probabilistic projection including rapid Antarctic ice sheet mass loss. Environ Res Lett. 2017;12: 044013.

17) Bakker AMR, Wong TE, Ruckert KL, Keller K. Sea-level projections representing the deeply uncertain contribution of the west Antarctic ice sheet. Sci Rep 2017;7: 3880.

18) Melet A, Meyssignac B, Almar R, Le Cozannet G. Under-estimated wave contribution to coastal sea-level rise. Nat Clim Chang. 2018;8: 234–39.

19) Kirezci E, Young IR, Ranasinghe R, et al. Projections of global-scale extreme sea levels and resulting episodic coastal flooding over the 21st century. Sci Rep. 2020;10: 11629.

20) Allison NL, Bindoff RA, Bindschadler PM et al. The Copenhagen Diagnosis: Updating the World on the Latest Climate Science. Sydney, Australia: The University of New South Wales, Climate Change Research Centre (CCRC), 2009.

21) Richardson K, Steffen W, Liverman D (eds). Climate Change: Global Risks, Challenges and Decisions. Cambridge: Cambridge University Press, 2011.

22) White I, Falkland T, Metutera T et al. Climatic and human influences on groundwater in low atolls. Vadose Zone J. 2007;6: 581– 90.

23) Kelman I. Island security and disaster diplomacy in the context of climate change. Les Cahiers de la Sécurité. 2006;63: 61– 94.

24) Perch-Nielsen SL, Bättig MB, Imboden D. Exploring the link between climate change and migration. Clim Change. 2008;4: 375– 93.

25) Caminade C, McIntyre KM, and Jones AE. Impact of recent and future climate change on vector-borne diseases. Annals of the New York Academy of Sciences. 2019;1436(1):157-173.

26) World Health Organization. https://www.who.int/health-topics/climate change#tab=tab_2 (accessed March 7, 2023)

27) World Health Organization. https://www.who.int/health-topics/climate-change#tab=tab_1 (accessed March 7, 2023)

28) De Sario M, Katsouyanni K, Michelozzi P. Climate change, extreme weather events, air pollution and respiratory health in Europe. Eur Respir J. 2013;42:826–843.

29) McIntyre KMC, Setzkorn PJ, Hepworth, et al. Systematic assessment of the climate sensitivity of impor- tant human and domestic animals pathogens in Europe. Sci. Rep. 2017;7: 7134.

30) Greenough G, McGeehin M, Bernard SM, Trtanj J, Riad J, and Engelberg D. The potential impacts of climate variability and change on health impacts of extreme weather events in the United States. Environmental health perspectives. 2001; 109(suppl 2): 191-198.

31) Stanke C, Kerac M, Prudhomme C, Medlock J, Murray V. Health effects of drought: a systematic review of the evidence. PLoS Curr. 2013; 5: 5.

32) Cianconi, Paolo, Sophia Betrò and Luigi Janiri. “The impact of climate change on mental health: a systematic descriptive review.” Frontiers in psychiatry 11. 2020; 74.

33) Hajat S, Ebi KL, Kovats RS, et al. The health consequences for flooding in europe and the implications for public health: a review of the evidence. Appl Environ Sci Public Health. 2003;1:13–21.

34) Hashim JH and Hashim Z. (2016). Climate change, extreme weather events, and human health implications in the Asia Pacific region. Asia Pacific Journal of Public Health. 2016;28(2_suppl): 8-14.

35) Romanello M, McGushin A, Di Napoli C, et al. The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future. Lancet. 2021;398:1619-1662.

36) Diffenbaugh NS, Scherer M. Observational and model evidence of global emergence of permanent, unprecedented heat in the 20(th) and 21(st) centuries. Clim Change 2011;107:615-624.

37) Kilbourne EM. Heat waves and hot environments. In: Noji EK, ed. The public health consequences of disasters. New York, New York: Oxford University Press, 1997:245– 69.

38) Lugo-Amador NM, Rothenhaus T, Moyer P. Heat-related illness. Emerg Med Clin North Am 2004;22:315–27.

39) Bouchama A, Knochel JP. Heat stroke. N Engl J Med. 2002;346:1978-1988.

40) Lipman GS, Gaudio FG, Eifling KP, Ellis MA, Otten EM, Grissom CK. Wilderness Medical Society clinical practice guidelines for the prevention and treatment of heat illness: 2019 update. Wilderness Environ Med 2019;30(Suppl 4):33-46.

41) Rublee C, Dresser C, Giudice C, Lemery J, Sorensen C. Evidence-based heatstroke management in the emergency department. West J Emerg Med. 2021;22:186-195.

42) Kovats RS, Hajat S, Wilkinson P: Contrasting patterns of mortality and hospital admissions during hot weather and heat waves in Greater London, UK. Occupational and Environmental Medicine. 2004, 61:893-898.

43) Knowlton K, Rotkin-Ellman M, King G, Margolis G, Smith D, Solomon G, Trent R, English P: The 2006 heat wave: impacts on hospitalizations and emergency department visits. Environmental Health Perspectives. 2009;117:61-67.

44) Josseran L, Fouillet A, Caillere N, Brun-Ney D, Ilef D, Brucker G, Medeiros H, Astagneau P: Assessment of a syndromic surveillance system based on morbidity data: results from the Oscour Network during a heat wave. PLos ONE. 2010; 5:e11984:1–8 www.plosone.org.

45) Knowlton K, Rotkin-Ellman M, King G, Margolis G, Smith D,Solomon G, Trent R, English P: The 2006 heat wave: impacts on hospitalizations and

emergency department visits. Environmental Health Perspectives. 2009;117:61-67.

46) Robine JM, Cheung SL, Le Roy S et al. Death toll exceeded 70000 in Europe during the summer of 2003. C R Biol. 2008;331: 171– 8.

47) Fouillet A, Rey G, Laurent F et al. Excess mortality related to the August 2003 heat wave in France. Int Arch Occup Environ Health. 2006;80:16–24.

48) Dear K, Ranmuthugala G, Kjellström T et al. Effects of temperature and ozone on daily mortality during the August 2003 heat wave in France. Arch Environ Occup Health. 2005; 60: 205–212.

49) Kinney PL. Climate change, air quality, and human health. American journal of preventive medicine. 2008; 35(5):459-467.

50) Heaney AK, Carrión D, Burkart K, Lesk C, Jack D. Climate change and physical activity: estimated impacts of ambient temperatures on bikeshare usage in New York City. Environ Health Perspect. 2019;127: 37002.

51) An R, Shen J, Li Y, Bandaru S. Projecting the influence of global warming on physical activity patterns: a systematic review. Curr Obes Rep. 2020; 9: 550–61.

52) Nazarian N, Liu S, Kohler M, et al. Project Coolbit: can your watch predict heat stress and thermal comfort sensation? Environ Res Lett. 2021; 16: 034031.

53) Andrews O, Le Quéré C, Kjellstrom T, Lemke B, Haines A. Implications for workability and survivability in populations exposed to extreme heat under climate change: a modelling study. Lancet Planet Health. 2018; 2: e540–47.

54) Clayton S, Manning C, Krygsman K and Speiser M. Mental health and our changing climate: Impacts, implications, and guidance. Washington, DC: American Psychological Association and ecoAmerica. 2017.

55) Younan D, Li L, Tuvblad C, Wu J, Lurmann F, Franklin M, ... and Chen JC. Long-term ambient temperature and externalizing behaviors in adolescents. American journal of epidemiology. 2018;187(9): 1931-1941.

56) Thompson R, Hornigold R, Page L, Waite T. Associations between high ambient temperatures and heat waves with mental health outcomes: a systematic review. Public health. 2018; 161: 171-191.

57) Gao J, Cheng Q, Duan J, Xu Z, Bai L, Zhang Y, ... and Su H. Ambient temperature, sunlight duration, and suicide: A systematic review and meta-analysis. Science of the total environment. 2019; 646: 1021-1029.

58) Norloei S, Jafari MJ, Omidi L, Khodakarim S, Bashash D, Abdollahi MB, Jafari M: The effects of heat stress on a number of hematological parameters and levels of thyroid hormones in foundry workers. Int J Occup Saf Ergon. 2015; 23:481-490.

59) Piil JF, Lundbye-Jensen J, Christiansen L, Ioannou L, Tsoutsoubi L, Dallas CN, Mantzios K, Flouris AD, Nybo L: High prevalence of hypohydration in occupations with heat-stress: perspectives for performance in combined cognitive and motor tasks. PLoS One. 2018; 13:e0205321 http://dx.doi.org/10.1371/journal.pone.0205321.

60) Basu R. 2009. High ambient temperature and mortality: a review of epidemiologic studies from 2001 to 2008. Environ. Health. 2009; 8: 40.

61) Yang J, Liu HZ, Ou CQ, Lin GZ, Zhou Q, Shen GC, Chen PY, Guo Y. 2013. Global climate change: impact of diurnal temperature range on mortality in Guangzhou, China. Environ. Pollut. 2013; 175: 131-136.

62) Bobb JF, Peng RD, Bell ML, Dominici F. 2014. Heat-related mortality and adaptation to heat in the United States. Environ. Health Perspect. 2014; 122: 811-816.

63) Ballester J, Robine JM, Herrmann FR, Rodo X. Long-term projections and acclimatization scenarios of temperature-related mortality in Europe. Nat. Commun. 2011; 2: 358.

64) Huang C, Barnett AG, Wang X, Vaneckova P, FitzGerald G, Tong S. Projecting future heat-related mortality under climate change scenarios: a systematic review. Environ. Health Perspect. 2011; 119: 1681-1690.

65) Li T, Horton RM, Kinney PL, 2013. Projections of seasonal patterns in temperature-related deaths for Manhattan, New York. Nat. Clim. Chang. 2013; 3: 717-721.

66) Petkova EP, Horton RM, Bader DA, Kinney PL. Projected heat-related mortality in the US urban northeast. Int. J. Environ. Res. Public Health.2013; 10: 6734-6747.

67) Vardoulakis S, Dear K, Hajat S, Heaviside C, Eggen B. 2014. Comparative assessment of the effects of climate change on heat- and cold-related mortality in the United Kingdom and Australia. Environ. Health Perspect. 2014; 122: 1285-1292.

68) Guo Y, Li S, Liu DL, Chen D, Williams G, Tong S. Projecting future temperature-related mortality in three largest Australian cities. Environ. Pollut. 2016; 208 (Part A): 66-73.

69) Kingsley SL, Eliot MN, Gold J, Vanderslice RR, Wellenius GA. Current and projected heat-related morbidity and mortality in Rhode Island. Environ. Health Perspect. 2016; 124: 460-467.

70) Semenza JC, Rubin CH, Falter KH, et al. Heat-related deaths during the July 1995 heat wave in Chicago. N Engl J Med. 1996;335:84 –90.

71) Bytomski JR, Squire DL. Heat illness in children. Curr Sports Med Rep. 2003;2:320 – 4.

72) Donaldson GC, Keatinge WR, Saunders RD. Cardiovascular responses to heat stress and their adverse consequences in healthy and vulnerable human populations. Int J Hyperthermia. 2003;19:225–35.

73) Vicedo-Cabrera AM, Scovronick N, Sera F, et al. The burden of heat-related mortality attributable to recent human-induced climate change. Nat Clim Chang. 2021;11:492-500.

74) Kovats RS, Hajat S. Heat stress and public health: a critical review. Annu Rev Public Health. 2008;29:41–55.

75) Basu R, Ostro BD. A multicounty analysis identifying the populations vulnerable to mortality associated with high ambient temperature in California. Am J Epidemiol. 2008;168:632–637.

76) Watts N, Amann M, Arnell N, et al. The 2020 report of the Lancet Countdown on health and climate change: responding to converging crises. Lancet. 2021;397:129-170.

77) CDC. Heat-related deaths—United States, 1999-2003. MMWR. 2006;55: 796 – 8.

78) D'Amato G, Cecchi L, D'Amato M, and Annesi-Maesano I. Climate change and respiratory diseases. 2014.

79) Joshi M, Goraya H, Joshi A, Bartter T. Climate change and respiratory diseases: a 2020 perspective. Current opinion in pulmonary medicine. 2020; 26(2): 119-127.

80) Liu L, Kauri LM, Mahmud M, Weichenthal S, Cakmak S, Shutt R, et al. Exposure to air pollution near a steel plant and effects on cardiovascular physiology: a randomized crossover study. International journal of hygiene and environmental health. 2014;217(2-3):279-86.

81) Bernard SM, Samet JM, Grambsch A, Ebi KL, Romieu I. The potential impacts of climate variability and change on air pollution-related health effects in the United States. Environmental health perspectives. 2001;109(suppl 2):199-209.

82) Brunekreef B, Holgate ST. Air pollution and health. The lancet. 2002;360(9341):1233-42.

83) Bayram H, Bauer AK, Abdalati W, Carlsten C, Pinkerton KE, Thurston GD, et al. Environment, global climate change, and cardiopulmonary health. American journal of respiratory and critical care medicine. 2017;195(6):718-24

84) Ion-Nedelcu N, Nitescu M, Caian M, Bacruban R, Ceausu E. Effect of air pollution upon the hospitalization for acute lower respiratory tract infections among the Bucharest municipality's residents [in Romanian]. Bacteriol Virusol Parazitol Epidemiol (Bucur) 2008;53:117–120.

85) Balmes JR. The role of ozone exposure in the epidemiologyof asthma. Environ Health Perspect. 1993;101(Suppl. 4):219–24.

86) Peden DB, Setzer RW, Devlin RB. Ozone exposure has both apriming effect on allergen induced responses as well as anintrinsic inflammatory action in the nasal airways of perennialallergic asthmatics. Am J Respir Crit Care Med1995;151:1336–45.

87) Kreit JW, Gross KB, Moore TBet al. Ozone-induced changes inpulmonary function and bronchial responsiveness in asth-matics. J Appl Physiol. 1989;66:217–22.

88) Scannell C, Chen LL, Aris RMet al. Greater ozone-inducedinflammatory responses in subjects with asthma. Am J RespirCrit Care Med. 1996;154:24–9.

89) Sandstrom T, Helleday R, Blomberg A. Air pollution andasthma: experimental studies. In: D'Amato G, Holgate ST, eds. The impact of air pollution on respiratory health. Europeanrespiratory Monograph n.21,Sheffield,UK: European Respira-tory Society Journals Ltd., 2002; 52–65.

90) Bayram H, Sapsford RJ, Abdelaziz MM, Khair OA. Effect ofozone and nitrogen dioxide on the release of proinflammatorymediators from bronchial epithelial cells on nonatopic, non-asthmatic subjects and atopic asthmatic patients in vitro. J Allergy Clin Immunol. 2001;107:287–94.

91) J ¨orres RA, Holz O, Zachgo W, Timm P, Koschyk S, M ¨uller B, Grimminger F, Seeger W, Kelly FJ, Dunster C, et al. The effect of repeated ozone exposures on inflammatory markers in bronchoalveolar lavage fluid and mucosal biopsies. Am J Respir Crit Care Med. 2000;161:1855–1861.

92) Barnes CS. Impact of climate change on pollen and respiratory disease. Current allergy and asthma reports. 2018; 18: 1-11.

93) Wayne P, Foster S, Connolly J, et al. Production of allergenic pollen by ragweed (Ambrosia artemisiifolia L.) is increased in CO2-enriched atmospheres. Ann Allergy Asthma Immunol. 2002; 88:279–282.

94) Emberlin J, Detandt M, Gehrig R, et al. Responses in the start of Betula (birch) pollen seasons to recent changes in spring temperatures across Europe. Int J Biometeorol. 2002; 46:159–170.

95) Ziska LH, Gebhard DE, Frenz DA, et al. Cities as harbingers of climate change: common ragweed, urbanization, and public health. J Allergy Clin Immunol. 2003; 111:290–295.

96) Ziska L, Knowlton K, Rogers C, et al. Recent warming by latitude associated with increased length of ragweed pollen season in central North America. Proc Natl Acad Sci U S A. 2011; 108:4248–4251.

97) Takaro TK, Knowlton K, Balmes JR. Climate change and respiratory health: current evidence and knowledge gaps. Expert Rev Respir Med. 2013; 7:349–361.

98) Lake IR, Jones NR, Agnew M, et al. Climate change and future pollen allergy in Europe. Environ Health Perspect. 2017; 125:3.

99) Poole JA, Barnes CS, Demain JG, et al. Impact of weather and climate change with indoor and outdoor air quality in asthma: a Work Group Report of the AAAAI Environmental Exposure and Respiratory Health Committee. J Allergy Clin Immunol. 2019; 143:1702–1710.

100) Bernard-Verdier, Maud, et al. "Grassland allergenicity increases with urbanisation and plant invasions." Ambio 51.11. 2022; 2261-2277.

101) Sheffield PE, Weinberger KR, Kinney PL. Climate change, aeroallergens, and pediatric allergic disease. Mt Sinai J Med. 2011; 78:78–84

102) Darrow LA, Hess J, Rogers CA, et al. Ambient pollen concentrations and emergency department visits for asthma and wheeze. J Allergy Clin Immunol. 2012; 130:630–638.e4.

103) Ito K, Weinberger KR, Robinson GS, et al. The associations between daily spring pollen counts, over-the-counter allergy medication sales, and asthma syndrome emergency department visits in New York City, 2002–2012. Environ Health. 2015; 14:71.

104) Beggs PJ, Bambrick HJ. Is the global rise of asthma an early impact of anthropogenic climate change? Environ Health Perspect. 2005; 113: 915– 9.

105) Mirsaeidi M, Motahari H, Taghizadeh Khamesi M, et al. Climate change and respiratory infections. Ann Am Thorac Soc. 2016; 13:1223–1230.

106) Bayard V, Kitsutani PT, Barria EO, Ruedas LA, Tinnin DS, Muñoz C, de Mosca IB, Guerrero G, Kant R, Garcia A, et al. Outbreak of hantavirus pulmonary syndrome, Los Santos, Panama, 1999-2000. Emerg Infect Dis. 2004;10:1635–1642.

107) Williams PL, Sable DL, Mendez P, Smyth LT. Symptomatic coccidioidomycosis following a severe natural dust storm: an outbreak at the Naval Air Station, Lemoore, Calif. Chest. 1979;76:566–570.

108) Biswas R, Pal D, Mukhopadhyay SP. A community based study on health impact of flood in a vulnerable district of West Bengal. Indian J Public Health. 1999;43:89–90.

109) Kondo H, Seo N, Yasuda T, Hasizume M, Koido Y, Ninomiya N, Yamamoto Y. Post-flood–infectious diseases in Mozambique. Prehosp Disaster Med. 2002;17:126–133.

110) Siddique AK, Baqui AH, Eusof A, Zaman K. 1988 floods in Bangladesh: pattern of illness and causes of death. J Diarrhoeal Dis Res 1991;9: 310–314.

111) Xu Z, Etzel RA, Su H, Huang C, Guo Y, Tong S. Impact of ambient temperature on children's health: a systematic review. Environ Res. 2012;117:120–131.

112) Xu Z, Hu W, Tong S. Temperature variability and childhood pneumonia: an ecological study. Environ Health. 2014;13:51.

113) Brumberg HL, Karr CJ, Bole A, Ahdoot S, Balk SJ, Bernstein AS, ... and Trasande L. Ambient air pollution: health hazards to children. Pediatrics. 2021; 147(6).

114) Kim, J. J. (2004). Ambient air pollution: health hazards to children. Pediatrics, 114(6), 1699-1707.

115) Bentayeb M, Simoni M, Baiz N, Norback D, Baldacci S, Maio S, Viegi G, Annesi-Maesano I; Geriatric Study in Europe on Health Effects of Air Quality in Nursing Homes Group. Adverse respiratory effects of outdoor air pollution in the elderly. In J Tuberc Lung Dis. 2012;16:1149–1161.

116) Simoni M, Baldacci S, Maio S, Cerrai S, Sarno G, Viegi G. Adverse effects of outdoor pollution in the elderly. J Thorac Dis. 2015;7:34–45.

117) Schwartz J. Air pollution and hospital admissions for the elderly in Detroit, Michigan. Am J Respir Crit Care Med. 1994;150:648–655.

118) Neupane B, Jerrett M, Burnett RT, Marrie T, Arain A, Loeb M. Longterm exposure to ambient air pollution and risk of hospitalization with community-acquired pneumonia in older adults. Am J Respir Crit Care Med. 2010;181:47–53.

119) Arbex MA, de Souza Conceição GM, Cendon SP, Arbex FF, Lopes AC, Moys ´es EP, Santiago SL, Saldiva PH, Pereira LA, Braga AL. Urban

air pollution and chronic obstructive pulmonary disease-related emergency department visits. J Epidemiol Community Health. 2009;63:777–783.

120) Medina-Ramón M, Schwartz J. Who is more vulnerable to die from ozone air pollution? Epidemiology. 2008;19:672–679.

121) Braks MAH and de Roda Husman AM. Dimensions of effects of climate change on water-transmitted infectious diseases. Air Water Borne Dis. 2013: 2(109): 2.

122) Stocker TF, Qin D, Plattner G-K, Tignor M, Allen SK, Boschung J, et al.,(Ed.). Climate change 2013: the physical science basis: Working Group I contribution to the Fifth assessment report of the Intergovernmental Panel on Climate Change. Cambridge university press; 2014.

123) Levy K, Woster AP, Goldstein RS, Carlton EJ. Untangling the impacts of climate change on waterborne diseases: a systematic review of relationships between diarrheal diseases and temperature, rainfall, flooding, and drought. Environ Sci Technol. 2016;50:4905–22.

124) Marcheggiani S, Puccinelli C, Ciadamidaro S, Della Bella V, Carere M, Francesca Blasi M, ... and Mancini L. Risks of water-borne disease outbreaks after extreme events. Toxicological & Environmental Chemistry. 2010; 92(3): 593-599.

125) Troeger C, Forouzanfar M, Rao PC, Khalil I, Brown A, Reiner RC, ... and Mokdad AH. Estimates of global, regional, and national morbidity, mortality, and aetiologies of diarrhoeal diseases: a systematic analysis for the Global Burden of Disease Study 2015. The Lancet infectious diseases. 2017; 17(9): 909-948.

126) Troeger C, Colombara DV, Rao PC, Khalil IA, Brown A, Brewer TG et al. (2018). Global disability-adjusted life-year estimates of long-term health burden and undernutrition attributable to diarrhoeal diseases in children younger than 5 years. The Lancet Global Health. 2018; 6(3): 255-269.

127) Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. The lancet. 2012; 379(9832): 2151-2161.

128) Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C. Et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The lancet. 2012; 380(9859): 2197-2223.

129) Campbell-Lendrum D, Manga L, Bagayoko M, Sommerfeld J. Climate change and vector-borne diseases: what are the implications for public health research and policy? Philosophical Transactions of the Royal Society B: Biological Sciences.2015; 370(1665): 20130552.

130) Scott TW, PH Amerasinghe PH, Morrison AC et al. Longitudinal studies of Aedes aegypti (Diptera: Culicidae) in Thailand and Puerto Rico: blood feeding frequency. J. Med. Entomol. 2000; 37: 89–101.

131) Martin V, Chevalier V, Ceccato P, Anyamba A, De Simone, L, Lubroth J, ... and Domenech J. The impact of climate change on the epidemiology and control of Rift Valley fever. 2008.

132) Keesing F, Belden LK, Daszak P, et al. Impacts of biodiversity on the emergence and transmission of infec- tious diseases. Nature. 2010; 468: 647–652.

133) World Health Organization, 1951. Expert Committee On Zoonoses. WHO Technical Report Series No 40.

134) Chomel BB. 2009. Zoonoses. In: Schaechter, M. (Ed.), Encyclopedia of Microbiology, 3rd Edition. Academic Press, Oxford, 2009; 820–829.

135) Rupasinghe R, Chomel BB, Martínez-López B. Climate change and zoonoses: A review of the current status, knowledge gaps, and future trends. Acta Tropica. 2022; 226: 106225.

136) Magouras I, Brookes VJ, Jori F, Martin A, Pfeiffer DU, Dürr S. Emerging zoonotic diseases: Should we rethink the animal–human interface?. Frontiers in veterinary science. 2020; 7: 582743.

137) Taylor LH, Latham SM, Woolhouse ME. Risk factors for human disease emergence. Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences. 2001; 356(1411): 983-989.

138) Reiter P. Climate change and mosquito-borne disease. Environmental health perspectives. 2001; 109(suppl 1): 141-161.

139) Brownstein JS, Holford TR, Fish D. Effect of climate change on Lyme disease risk in North America. EcoHealth. 2005; 2: 38-46.

140) Li T, Yang Z, Dong Z, Wang M. Meteorological factors and risk of scrub typhus in Guangzhou, southern China, 2006–2012. BMC infectious diseases. 2014; 14(1): 1-8.

141) Cheke RA, Basánez MG, Perry M, White MT, Garms R, Obuobie E, ... and Wilson MD. Potential effects of warmer worms and vectors on onchocerciasis transmission in West Africa. Philosophical Transactions of the Royal Society B: Biological Sciences. 2015; 370(1665): 20130559.

142) Craufurd PQ, Wheeler TR. Climate change and the flowering time of annual crops. J Exp Bot. 2009; 60: 2529–39.

143) Food and Agriculture Organization. New food balance sheets. http://www.fao.org/faostat/en/#data/FBS (accessed on March 8, 2023).

144) Food and Agricultural Organization. The State of Food Insecurity in the World, 2009. Rome, Italy: FAO, 2010.

145) Peng S, Huang J, Sheehy JE et al. Rice yields decline with higher night temperature from global warming. PNAS. 2004; 101: 9971– 5.

146) Lobell DB, Asner GP. Climate and management contributions to recent trends in US agricultural yields. Science. 2003; 299(5609), 1032-1032.

147) Battisti DS, Naylor RL. Historical warnings of future food insecurity with unprecedented seasonal heat. Science. 2009; 323(5911): 240-244.

148) Morton John F. "The impact of climate change on smallholder and subsistence agriculture." Proceedings of the national academy of sciences. 2007; 104(50): 19680-19685.

149) Brown ME, Christopher CF. "Food security under climate change." Science. 2008; 319(5863): 580-581.

150) Black RE, Allen LH, Bhutta ZA, Caulfield LE, De Onis M, Ezzati M, ... and Rivera, J. Maternal and child undernutrition: global and regional exposures and health consequences. The lancet. 2008; 371(9608): 243-260.

151) Friel S, Bowen K, Campbell-Lendrum D, Frumkin H, McMichael AJ, Rasanathan K. Climate change, noncommunicable diseases, and development: the relationships and common policy opportunities. Annual review of public health. 2011; 32: 133-147.

152) Brook RD, Franklin B, Cascio W, Hong Y, Howard G, Lipsett M, ... and Tager I. Air pollution and cardiovascular disease: a statement for healthcare professionals from the Expert Panel on Population and Prevention Science of the American Heart Association. Circulation. 2004; 109(21): 2655-2671.

153) Huq S, Kovats S, Reid H, Satterthwaite D. Reducing risks to cities from disasters and climate change. Environment and urbanization. 2007; 19(1): 3-15.

154) McCarty C, Taylor H. A review of the epidemiologic evidence linking ultraviolet radiation and cataracts. Developments in ophthalmology. 2002;35:21-31.

155) van der Leun JC, Piacentini RD, de Gruijl FR. Climate change and human skin cancer. Photochemical & Photobiological Sciences. 2008;7(6):730-3.

156) World Health Organization. (2008). The global burden of disease: 2004 update. World Health Organization.

157) Hayward G, Ayeb-Karlsson S. 'Seeing with empty eyes': a systems approach to understand climate change and mental health in Bangladesh. Clim Change 2021; 165: 29.

158) Kelman I, Ayeb-Karlsson S, Rose-Clarke K, et al. A review of mental health and wellbeing under climate change in small island developing states (SIDS). Environ Res Lett. 2021; 16: 033007.

159) Mullins JT, White C. Temperature and mental health: evidence from the spectrum of mental health outcomes. J Health Econ. 2019; 68: 102240.

160) Obradovich N, Migliorini R, Paulus MP, Rahwan I. Empirical evidence of mental health risks posed by climate change. Proceedings of the National Academy of Sciences. 2018; 115(43): 10953-10958.

161) Ursano RJ, Morganstein JC, Cooper R. Resource Document on Mental Health and Climate Change. APA Document; 2017.

162) Blanc J, Spruill T, Butler M, Casimir G, Jean-Louis G. 0885 Is resilience a protective factor for sleep disturbances among earthquake survivors? Sleep. 2019; 42: A356.

163) Weir K. "Climate change is threatening mental health". July/August 2016; 47(7): 28

164) Fernandez A, Black J, Jones M, Wilson L, Salvador-Carulla L, Astell-Burt T, Black D. Flooding and mental health: a systematic mapping review. PloS one. 2015; 10(4): e0119929.

165) Orengo-Aguayo R, Stewart RW, de Arellano MA, Suárez-Kindy JL, Young J. (2019). Disaster exposure and mental health among Puerto Rican youths after Hurricane Maria. JAMA network open. 2019; 2(4): 192619

166) Nahar N, Blomstedt Y, Wu B, Kandarina I, Trisnantoro L, Kinsman J. Increasing the provision of mental health care for vulnerable, disaster-affected people in Bangladesh. BMC public health. 2014; 14: 1-9.

167) Schwartz RM, Gillezeau CN, Liu B, Lieberman-Cribbin W, Taioli E. Longitudinal impact of Hurricane Sandy exposure on mental health symptoms. International journal of environmental research and public health.2017; 14(9): 957.

CHAPTER VI

REHABILITATION AND NURSING CARE IN THE ELDERLY

Gülay TURGAY[1] & Çiğdem ÖZDEMİR ELER[2]

[1](Asst. Prof. Dr.) Başkent University,
Vocational School of Health Services, Ankara, Turkey,
e-mail: gturgay@baskent.edu.tr,
ORCID: 0000-0003-2790-1426

[2]Başkent University, Vocational School of
Health Services, Ankara, Turkey,
e-mail: cigdemo@baskent.edu.tr,
ORCID: 0000-0002-5900-4220

1. Introduction

Rehabilitation comes from the Latin word Habil, and habilitation is defined as learning something unknown. Rehabilitation; Treatment aimed at minimizing the consequences of permanent disabilities, aiming to make the individual who has lost some of his abilities due to congenital or later illness, accident or injury to the best possible level in terms of medical, psychological, social and professional aspects and to make him more useful to himself, his family and society. It is a compelling work process.

A number of physiological changes in the body are inevitable with aging. The addition of various diseases to these physiological changes causes many problems such as pain, limitation of activity and decrease in participation in the elderly, and the quality of life of the elderly person deteriorates. In order to overcome the problems that may be experienced in the elderly, well-planned comprehensive health services, in other words "geriatric rehabilitation" is needed.

Rehabilitation is an important dimension of geriatric health care. The majority of the elderly have difficulty in performing activities of daily living

independently as a result of loss of function due to age-related changes and chronic diseases. These individuals need to be supported in achieving optimal independence through rehabilitation interventions.

2. Basic Philosophy of Rehabilitation

The basic philosophy of rehabilitation; It includes revealing the dignity and importance of the elderly individual by giving importance to the concepts of respect, self-confidence, love and value. The purpose of geriatric rehabilitation; In the process ranging from the limitations caused by a medical and surgical event to the elderly, to losses; attempting to regain functional independence and regain the ability to perform activities of daily living as much as possible (1).

Basic principles in geriatric rehabilitation;

- ✓ Determining the functional level
- ✓ Consider changing physiological capacity
- ✓ Determining the family's expectations
- ✓ To determine his psychological state
- ✓ Identifying the patient's goals and motivation
- ✓ To know that patients may have many disorders that affect each other.
- ✓ Aiming at treatment and function, not diagnosis
- ✓ Knowing that function can be regained
- ✓ Knowing that progress will occur slowly
- ✓ Evaluate available resources and options
- ✓ Using the least number of drugs
- ✓ Avoid inactivity
- ✓ Emphasizing task-specific exercise program, keeping it simple
- ✓ Encouragement for social life

In line with these principles, the health status and social and economic status of the elderly are evaluated. A rehabilitation program is established for the elderly. This program covers not only the treatment of diseases but also all the needs of the individual (1,2).

The most important point in geriatric rehabilitation is that each patient has unique needs. If the rehabilitation plan is created individually, its success increases. A prerequisite for this plan is the functional evaluation of the geriatric patient. The goals determined for the patient after the functional evaluation

should be determined by considering the physiological, social, economic, familial, cognitive, cultural and social conditions of the patient as well as the available opportunities. The basic philosophy of geriatric rehabilitation; It includes revealing the dignity and importance of the elderly individual by giving importance to the concepts of respect, self-confidence, love and value (2,3,4).

3. Implementation Places of Rehabilitation

Rehabilitation can be applied in hospitals, rehabilitation centers, specialized nursing homes, nursing homes, clinics, outpatient services of hospitals and in the home environment (4).

Hospitals: Patients are usually admitted to the hospital for diagnostic and other evaluations, short-term treatments, post-discharge treatment and follow-up programs, and family education during the initial stages of their illness. Hospitalization and treatment time in hospitals are usually short due to facilities and health payment systems. One of the most important decisions to be made here is where the old people will be sent when they go, that is, where their rehabilitation will be done (4,5).

Inpatient Rehabilitation Centers: Often work as a separate unit from hospitals. It houses all the health workers who make up the rehabilitation team. Specialized rehabilitation program for each patient is implemented with an interdisciplinary approach. It generally provides more intensive rehabilitation services than other units (4).

Nursing Homes: It is a boarding social service institution established to provide care and protection for the elderly in need of special care. After hospital-based rehabilitation services, decisions are made about patients to be followed at home, with outpatient services or in specialized nursing homes. These nursing homes can have a wide variety of features. While the facilities of some are as developed as rehabilitation centers, others are limited (4).

Rest Homes: It is a boarding social service institution established to protect the elderly in a peaceful environment, to care for them, and to meet their social and psychological needs. It can serve only during the day or on a full-time basis (4).

Outpatient Rehabilitation Programs: These programs are usually implemented by the outpatient clinics of hospitals. It can be in the form of a detailed rehabilitation program, or it can only consist of physical therapy and rehabilitation outpatient clinic. The advantage of this program is that the patient can be followed while living at home. The patient does not lose his social

relations and even allows socialization by communicating with other patients and their relatives. The patient spends certain days of the week in the hospital on a programmed schedule. The most important problem to be solved in such programs is access to the hospital (4,6).

Home Rehabilitation Program: These programs often consist of physical therapy, occupational therapy and nursing services. Sometimes accompanied by a speech therapist and social worker. These programs can increase their capacity with the participation of physicians and other employees. Its advantage is that it is applied in the environment where the patient is present (4,7).

4. Geriatric Rehabilitation Team

Different healthcare professionals collaborate at different stages of the rehabilitation process. These team members are;

- ✓ Physician
- ✓ Nurse
- ✓ Physiotherapist
- ✓ Occupational therapist
- ✓ Speech therapist
- ✓ Psychologist
- ✓ Nutrition Specialist
- ✓ Social Worker
- ✓ Orthotics-Prosthetics Specialist
- ✓ Professional Consultant
- ✓ Recreational therapist (3,4).

Nurses are involved in every stage of rehabilitation. The duties and functions of nurses are numerous in facilitating daily life activities. It has very important functions in educating both patients and caregivers.

5. Characteristics of the Rehabilitation Nurse

- ✓ Ability to communicate positively and be a good listener,
- ✓ To be able to work effectively in the field of rehabilitation, to know concepts and theories such as human, health-disease, environment, theories of change and learning, growth-development, sexuality,

✓ To have the knowledge, skills and experience to provide education, to be a patient and good educator in order to gain the knowledge and skills necessary for the patient and his family to gain independence,

✓ To know diseases and their effects on systems,

✓ It is necessary to have sufficient knowledge and skills in subjects such as disease prevention, disability and complications (1,5,6).

Rehabilitation nursing standards, which were revised and finalized by the Association of Rehabilitation Nurses (ARN) in 1994; maintenance standards and professional performance standards.

Rehabilitation Nursing Care Standards

➢ Diagnostics: Data collection

➢ Nursing diagnosis: diagnosing the nature and source of patient problems

➢ Determining outcome criteria: determining patient goals

➢ Planning: planning for nursing purposes

➢ Practice: practicing nursing interventions

➢ Evaluation: evaluating nursing interventions (8).

Rehabilitation Nursing Professional Performance Standards

• Standard I

Quality of Care: The rehabilitation nurse systematically assesses the quality and effectiveness of rehabilitation practices.

• Standard II

Capturing Performance: Rehabilitation nurse evaluates nursing practices in their field about professional practice standards, related situations and regulations.

• Standard III

Education: Rehabilitation nurse monitors up-to-date information in their practices and ensures that the level of knowledge reaches the highest level through continuous education.

• Standard IV

Professional Association: Rehabilitation nurse assists in the professional development of friends, colleagues, nurse students and other individuals.

• Standard V

Ethics: The decisions and behaviors to be taken by the rehabilitation nurse on behalf of the patient are determined in line with the principles of ethical rules.

• Standard VI

Collaboration: Rehabilitation nurse cooperates with the patient, the patient's family and relatives and health professionals in providing care.

• Standard VII

Research: Rehabilitation nurses use research findings (evidence-based data) in their practices and share their own findings with professional staff.

• Standard VIII

Resource Usage: The rehabilitation nurse provides quality care by considering the factors related to safety, efficiency and cost in planning and implementing care (1,5,6).

In geriatric rehabilitation; Many theories guide rehabilitation nurses to achieve maximum standard goals and achieve optimal care and goals. Some theories such as nursing communication theory, self-care theory, daily living activities model, care-self-treatment theory belong to nurse theorists, as well as theories developed by other professions. These theories, which facilitate and clarify the understanding of the philosophy of rehabilitation nursing, provide a holistic perspective to the rehabilitation process and form the basis for the planning, implementation and evaluation of the nursing process in rehabilitation (7).

Acute goals of rehabilitation;

✓ Stabilizing primary problems,

✓ To prevent secondary complications (pressure ulcers, pneumonia, contractures),

✓ To restore lost functions.

In the chronic phase of rehabilitation, restoring lost functions is the primary goal. Rehabilitation of the elderly person; It includes balance exercise and functional activity program (weight bearing exercises, ambulation, self-lifting, reaching) to increase functional mobility and capacity, good nutrition, good care (hygiene, continence, rest) and emotional support.

Before starting the rehabilitation program, the functional status, general health, physiological function and capacity of the elderly individual should be evaluated comprehensively by the rehabilitation team. Rehabilitation nurse should diagnose the physical, social, emotional, intellectual and spiritual dimensions while evaluating the elderly individual and use appropriate diagnostic tools for this. By evaluating the data obtained from the diagnosis, the nurse plans and implements the appropriate interventions and evaluates their results (8,9,10).

6. Basic approach in geriatric patient evaluation

Comprehensive geriatric evaluation is important in the evaluation of the geriatric patient. After Comprehensive Geriatric Evaluation (CGD), 28% decrease in 6-month mortality rates in centers applying geriatric rehabilitation reveals the importance of evaluation. Evaluation should be done interdisciplinary and multidisciplinary.

Physical health: history and physical examination, assessment of vision and hearing functions, assessment of continence, assessment of walking, mobility and fall, assessment of nutrition, assessment of functional ability (activities of daily living, activities of daily living, performance criteria).

Mental health: cognitive screening and assessment, depression screening and assessment, assessment of social supports (social history, measurement and referral of support, caregiver burden, economic status), and assessment of environmental competence (11,12,13).

Another method for evaluating geriatric patients is The Domain Management Model. In this model, the patient is assessed in four areas: 1. Medical problems, 2. Mental state\affective\coping, 3. Physical function, 4. Life environment.

Space Management Model

1. Medical/surgical conditions (diseases, syndromes)

2. Mental state\affective\coping (cognitive state, emotions, coping mechanisms, spirituality)

3. Physical function (simple activities of daily living: mobility at home, self-care, moderate activities of daily living: mobility in the community, advanced activities of daily living: occupational and non-occupational)

4. Living environment (physical, social, financial).

After a well-made evaluation, goals are set. Plans should be made together and thoughts should be shared so that there is no conflict between the goals of the patient, the patient's relatives and the rehabilitation team. Then the program should be edited. (12,13,14).

7. Rehabilitation Nursing Initiatives

Appropriate Exercise Program: Exercise is important for a healthy and active aging process. The physical activity status of the elderly person should be analyzed. Since lack of physical activity is associated with many chronic diseases such as coronary artery disease, hypertension, and osteoporosis, exercise programs to increase physical activity should be recommended to elderly individuals. It is reported that more than 40% of individuals over 65 years of age lead a sedentary life. The aim of the exercise program prepared and applied for elderly individuals should be to increase joint range, muscle strength, cardiovascular capacity and bone demineralization and to correct posture. It should not be forgotten in the exercise program of the elderly, that the learning and motor movements of the elderly are slow; It is easy for them to get tired. It is recommended to use complex exercises in terms of ease of learning, recall and performance. Exercise frequency, intensity and duration should be increased gradually within a plan. Elderly people who are not accustomed to physical exertion may experience fatigue after an exercise program. Pain and increased fatigue after exercise may prevent the elderly person from continuing the exercises. Before starting the exercise, warm-up movements should be done, and after the exercise, cooling movements should be done without interrupting the exercise. If the elderly feel an unusual situation during the exercise, they should pause or stop the exercise (15,16).

Adequate and Balanced Nutrition: It may affect the nutrition of the elderly person; Physiological, psychological, socioeconomic causes, diseases, drug-nutrient interaction should be diagnosed by the nurse. Taste and smell changes, gastrointestinal changes such as swallowing difficulties, physical causes such as sedentary life affect nutrition. In general, the factors that negatively affect

the nutrition of the elderly; the elderly live alone, have a physical disability that will make food shopping, food preparation and cooking difficult or impossible, the absence of persons and institutions to assist in this regard, problems with chewing and teeth, and lack of income to ensure adequate nutrition (17,18).

In addition to these, diseases that increase or decrease appetite, nutritional needs or drugs used, depression or mental problems; affects the nutritional status of the elderly. In the nutrition of the elderly, calorie, mineral and vitamin intake should be prepared in a sufficient and balanced manner, if possible, under the supervision of a dietitian (19).

For optimal functionality, muscle facilitating techniques for swallowing, closing the mouth and keeping the head upright can be applied by physiotherapists in the elderly. In addition, suitable posture, supportive seats and assistive devices while eating can be used (19).

Mental Status: Dementia, which is seen with a frequency of 5% in elderly individuals over the age of 65 and 20% in those over the age of 80, may cause patients to be unable to adapt to rehabilitation programs due to weakened short-term memory. For this reason, it can be ensured that the elderly individuals benefit from the rehabilitation program better by providing their families with trainings on appropriate care. At the same time, depression, which is seen in most of the elderly individuals, can significantly affect participation in the exercise program and prevent rehabilitation. Therefore, professional help should be sought when necessary. In interventions to be planned for memory problems, the pace of new learning should be slowed down, the practices should be repeated, the procedures to be applied should be explained to the patient carefully and slowly, and new materials should be associated with old ones (14,20).

Drug Use: Paying attention to the basic principles of rational drug use in the elderly plays a key role in the success of rehabilitation. After the physician determines the necessity of drug treatment, the nurse has important responsibilities in ensuring and maintaining the compliance of the elderly individual with the drug, which is the most important dimension. While planning drug treatment for the elderly individual, it should be individualized in the education to be given as well as a personalized treatment plan. It has been reported that drug education programs prepared in an individualized manner positively affect the drug knowledge of elderly individuals, and it is pointed out that nurses should play an important role in helping elderly individuals manage their drugs successfully. Practices to increase drug compliance should start with the creation of a drug use scheme specific to the elderly individual and should be

given to the individual in a clearly written form. The drug dose should be written in capital letters on the drug boxes, and the purpose of use of each drug should be explained. The importance of consulting a physician in case of undesirable effects should be explained. It should be checked whether the elderly individuals comply with the drug use, by counting the remaining tablets. The patient should be given a daily medication box. The name of the medicine, the dose and the time of taking it should be written clearly on this box. The medicine box should be small for ease of carrying and care should be taken to ensure that the shape and color of the tablets are made of a hard and transparent material that can be seen. If an elderly individual has difficulty swallowing, liquid forms should be preferred over solid forms of drugs. At the same time, the nurse should be alert to the side effects of drugs and should not allow these symptoms to interfere with rehabilitation by recognizing the side effects early (21,22).

Social and Environmental Factors: With old age, physical capacity, self-confidence, independence and income level decrease or disappear. Apart from medical problems, these conditions greatly affect the general health status of the elderly individual. The physical environment, home and social environment of the elderly individual should be evaluated in detail in terms of the effectiveness and continuity of rehabilitation (23).

Old age is usually a period in which living spaces are limited. Decreases in auditory and visual perceptions, disorders in coordination and balance, and decreased strength that occur with aging cause the elderly to face dangers and there is a need to arrange housing in a way that will facilitate their lives. Stairs, bathroom and toilet, kitchen, heating, lighting and ventilation equipment in the house of the individual should be reviewed. These equipment should be made supportive and useful for the patient, and possible accident risks should be minimized. The status of the elderly person's family, their competencies and relations with the family, the size and number of social networks, the support that the family has given to the elderly person in the past and that they can give in the future should be determined (18,24).

Problems of Touch, Sight and Hearing: Decreased vision and cataracts in elderly individuals are very common disorders, but they can hinder the rehabilitation process and education of the elderly. Visual impairment is also a risk factor for falls, which can negatively affect the quality of life of the elderly. The nurse should pay attention to the written materials used in the education of the visually impaired elderly individuals to be written in large fonts, to use strong contrast colors, to keep the details in the pictures to a minimum, and to provide

bright but diffused lighting. used, the figures are clearly drawn, the glasses used by the patient are clean. It should be spoken slowly against the progressive hearing loss and inability to distinguish sounds in the elderly person, the lip movements should be pronounced clearly, without excessive exaggeration, speaking in a normal voice, the patient should be able to see the educator's face clearly, the educator should use body language, and the assistive hearing aids used by the patient should be used make sure it works. Depending on the decrease in the sense of touch and coordination in elderly individuals, there may be difficulties in holding small objects, writing and prolonging the response time. In these cases, the patient should be given time and encouragement for the application (20,21,25).

Falls and Accidents: Problems related to walking, decreased sense of position due to deformities, balance problems are factors that increase the tendency to fall in elderly individuals, and vision and hearing problems, memory loss and drug side effects may worsen these conditions. Deformities in the feet, which can cause problems especially in walking exercises, and foot pain caused by various reasons should be determined beforehand and necessary precautions should be taken. Balance problems of the elderly should be tried to be diagnosed by asking whether they have a history of falling before, and the elderly should be supported and persuaded to use assistive devices such as walking sticks and walkers when necessary (1,26).

Excretory System Problems: Incontinence is a more prominent problem in women due to weakening of the pelvic muscles and sphincters. On the other hand, in elderly men, when urine output is blocked due to benign prostatic hypertrophy, frequent and less urine leakage can be seen. The excretory habits of elderly individuals with problems related to the excretory system should be diagnosed, incontinence should be questioned, and the cause of incontinence (urine and fecal incontinence), if any, should be revealed. After the cause is determined, the appropriate treatment approach should be determined (27).

References

1. Fadıloğlu Ç, Toke, Y. The role of the nurse in geriatric rehabilitation. Turkish Journal of Geriatrics.2004;7(4);241-246.

2. Borman P. Geriatric rehabilitation principles. International Institute on Aging Geriatrics Society Geriatrics and Gerontology II. Ankara; 2009; 396-403.

3. Holy YG. Geriatric rehabilitation principles and geriatric rehabilitation team. Turkish Physical Medicine and Rehabilitation Association Geriatric Rehabilitation Working Group. Ankara;2010: 211-224.

4. Yağcı İ. Geriatric rehabilitation and 5N-1K. https://geriatric.org. Access Date: 05.12.2022

5. Şahin GA. New field: gerokinesiology. Journal of Geriatric Sciences. 2020; 37-43.

6. Akdemir N, Akkuş Y. Rehabilitation and nursing, Journal of the School of Nursing. 2006; 82–91.

7. Korkmaz M, Korkmaz D. Nursing care for elderly individuals in home accidents and falls. Journal of Samsun Health Sciences. 2022;7(3): 629-636.

8. Canlı S, Çetinkaya Y, Uğur S. Advanced care planning process for elderly patients with dementia and the role of the nurse: traditional review. Turkey Clinics Journal of Nursing Sciences. 2022; 14(4):1232-9.

9. Christensen KL, Winters Ca, Colclough Y, Oley E, Luparell S. Advance care planning in rural montana: exploring the nurse's role. J Hosp Palliat Nurs. 2019;21(4):264-71.

10. Çilesiz N, Behdioğlu S. Evaluatıon of the servıce qualıty by structural equatıon modelıng: case of nursıng home-nursıng home elderly care and rehabılıtatıon center. Dumlupınar Unıversıty Journal of Feas. 2022; (10): 82-95.

11. Erci B. Public health nursing, elderly health. 2nd Edition. Elaziğ. Güler Publisher. 2016; 177-184.

12. Karadokovan A. Elderly health and care, an overview of old age. Ankara. Özyurt Publisher.2016; 9-11.

13. Aylaz R. Elderly health and nursing care. İnönü University Publishing House. 2019.

14. Çağlar T. Elderly Care Models and Practices. 1st Edition, Ankara: Nika Publishing House; 2017.

15. Gürer A, Çırpan KF, Ozlen AN. Aged care services. Journal of Health Services and Education. 2019; 3(1):1-6.

16. Turaman C. Planning of elderly health services in primary care. Geriatrics. 2014; (1): 22-27.

17. Eyigör S, Factors affecting quality of life in the elderly. https://geriatric.org. Access Date: 05.12.2022.

18. Gürer A, Çırpan KF, Özen NA. Elderly care services. Journal of Health Services and Education. 2019; 3(1): 2636-8285.

19. Arpacı F, Topyürek Ş, Bilgili N. Quality of life in elderly people living in nursing homes. Journal of Research on Elderly Issues. 2015;1:-11.

20. Aylin N. Aging, the individual and society: A sociological perspective on aging. Ege Journal of Medicine. 2016; 1-5.

21. Çapan EB. Living with the elderly: stress and coping. Journal of Research on Elderly Issues. 2016; 12:33-47.

22. Erol S, Sezer A, Şişman NS, Öztürk S. The Perceptıon of lonelıness and lıfe satısfactıon at older people. Gümüşhane University Journal of Health Sciences. 2016; 3:60-69.

23. Yücel ŞÇ, Ergin E. Comfort in old age. Journal of Continuing Medical Education. 2020; 29 (1): 69-73.

24. Şahin NE, Emiroğlu O. Quality of life and factors affecting the quality of life of the elderly living in nursing homes. Journal of Hacettepe University Faculty of Nursing. 2014; 1(1): 57-66.

25. Mollaoğlu M, Hastaoğlu F. Determination of the life satisfaction of elderly people living in nursing homes. Journal of Current Researches on Health Sector.2017; 7(2): 21-28.

26. Tang SK, Tse MMY, Leung SF, Fotis T. The effectiveness, suitability, and sustainability of non-pharmacological methods of managing pain in community-dwelling older adults: A systematic review. BMC Public Health. 2019;19(1):1-10. 8.

27. Karaca NG. Elderly rights and social work practices in the context of ınternational principles and standards. Social Security Journal.2019; 9(2); 255 – 274.

CHAPTER VII

THE IMPORTANCE OF TECHNICAL QUALITY FOR DIAGNOSIS IN PATHOLOGY LABORATORY

Yasemin SEZGİN

(*Asst. Prof. Dr.) Başkent University, Vocational School of Health Services*
e-mail: ysezgin@baskent.edu.tr
ORCID: 0000-0003-3059-5941

1. Introduction

Pathology is a branch of science that has an important place in the diagnosis of disease. It provides to reach important findings about diseases by examining the changes in tissues and cells morphologically. This special branch of science is closely related to all clinical sciences. In the field of pathology, which has such an important place in the diagnosis of the disease, technical quality is one of the most important factors to reach the correct diagnosis.

The pathology laboratory is a complex unit where many different techniques are applied and knowledge and skills are important in technique. Although they seem to be interconnected in the pathology laboratory, special knowledge and skills are required for each step of the procedure. In the pathology laboratory, which is constantly developing with the developing technology, continuous training and a advance technical knowledge are mandatory in order to adapt to new technologies.

The functional parts of a pathology laboratory, which differ according to the difference of the sample, are as follows;

Basic process steps;

- Sample acceptance and numbering
- Macroscopic evaluation

- Sectioning and fixation
- Decalcifications
- Tissue Proccessing
- Tissue Embedding
- Microscopic sectioning
- Deparaffinization
- Histologic Staining
- Mounting and clossing
- Microscopic evaluation
- Preparation of cytological samples
- Staining of cytological samples
- Preparation of Frozen Section

Special technics;

- Tissue preparation for histochemical evaluation
- Histochemical staining
- Interpretation of histochemical stains
- Tissue preparation for immunohistochemical evaluation
- Immunohistochemical staining
- Interpretation of immunohistochemical stains
- Tissue preparation for molecular pathological techniques
- Application of molecular pathological techniques
- Interpretation of molecular pathological technique results

Other operations;

- Creation of the patient report
- Archiving process
- Preparation of chemical solutions
- Storage of chemicals and stock control
- Regular device maintenance and maintenance follow-ups
- Follow-up of quality control in the laboratory

Knowledge and skills based on solid infrastructure training are required for each process step to run smoothly. When these procedures are carried out correctly, it is possible to reach the correct pathological diagnosis.

Although the macroscopic evaluation of these stages, microscopic diagnosis, interpretation of immunohistochemical stains, interpretation of molecular pathological technique results and the creation of patient reports are performed by pathologist physicians, the effect of the correct execution of pathology laboratory techniques on the result is clearly seen.(1,2,4,5)

2. Main Steps of Histologic Preparation Technique

The operations performed in these steps are discussed in detail below.

2. 1. Sample Acceptance and Numbering

Samples coming to the pathology laboratory from surgery and other clinics should be sent in accordance with the "Specimen Submission Directive" established by the pathology laboratory. During sample acceptance, the sample is accepted by checking the "sample acceptance and rejection criteria" created in line with this directive. During sample acceptance, the sample sent and the request form filled by the sending physician are taken by checking the patient information, and a laboratory number suitable for the characteristics of the incoming sample is given. The given laboratory number is written on both the sample and the patient request form and recorded in the computer environment and in the laboratory logbook. The processes in the laboratory are followed with this number. The first step of the correct diagnosis is the process of sending, checking, accepting and numbering the sample correctly (2,4,5).

2. 2. Macroscopic Evaluation

Macroscopic evaluation is a procedure performed under the supervision of a specialist pathologist and assisted by a pathology laboratory technician. The diagnosis of the patient and the information in the patient form are checked, and the visible features of the incoming material are recorded first. For example, the shape, size, weight of the tissue, prominent features (bleeding areas, presence of metal clips or threads on it, having a smooth or rough surface, etc.) are recorded. The specialist pathologist opens the sample and defines the lesion area and takes 3 mm thick sections from different parts of this area. The sections taken from which part of the lesion and how many are taken are written on the cassette and the internal follow-up form with the help of the pathology technician and placed on the cassettes. In excisional biopsies, in order to determine the distance of the lesion to the surgical margin and to define whether the lesion continues at the

surgical margin, the border is determined by staining with different colored dyes or ink. If necessary, the pathologist can prepare a frozen tissue section or imprint preparation from the lesion without fixation, so that special staining techniques that may be important for the diagnosis of the patient can be made, and they are recorded and stored in the freezer for further evaluation.

The next most important step is to perform the fixation process correctly and in sufficient time (9).

2. 3. Fixation

Tissue samples sent to the pathology laboratory require that all structures that make up the tissue be preserved as they were removed from the original living body. Tissue removed from the body of a living thing maintains its vitality for a short time and exhibits the morphological signs of the disease they carry (if any).

Fixation process; It is performed in order to prevent the environmental factors such as heat and humidity of the tissues and various factors such as bacteria and enzymes from causing morphological deterioration on the tissue.

After a while, unfixed tissues will be exposed to the attacks of environmental bacteria that settle on the tissue and begin to multiply by using the tissue as a medium in order to use the rich organic molecules they contain. Bacterial enzymes and toxins will break down tissue structures and cause what we call putrefaction or decay. Fixation also inhibits cellular digestion, which we call autolysis. Tissues left in contact with air or in an unsuitable environment for a long time swell, shrink and their membranes may burst.

Therefore, a successful fixation process is one of the most important steps of technical quality. Major errors in fixation unfortunately cause irreversible tissue damage.

Fixation, which is the most important step of preparing a quality preparation, is a process that succeeds in preserving the tissue until a microscopic section is prepared by affecting organic molecules such as protein, lipid and carbohydrate in the protoplasm. The most important effects of detection are seen on proteins. When we consider the cell, which is our most basic building block, we see that the microtubules and microfilaments that make up the skeleton of the cell have a protein structure. Also, the secretions that provide functionality in the cell and all enzymes (that carry out synthesis and destruction events) are in protein structure, the software in our DNA encodes proteins. Let's remind. The chemicals we use for detection stabilize the proteins by coagulating the proteins

or forming cross-links between the proteins. Thus, proteins, which are our most basic building blocks, can protect everything with their relations in the living state by preserving their positions in living tissue. It is known that the detection and the chemicals used in the fixation process do not have much effect on lipids. It has been reported that conventional fixation and tissue tracking processes lead to loss of lipids. If lipids need to be evaluated, frozen sections should be preferred. As for carbohydrates, fixation is possible with the use of alcohol-containing fixatives if a special consideration of carbohydrates is required, since glycogen mucopolysaccharides dissolve in water.

We can talk about two main fixatives that differ in their mechanisms of action and are generally used in pathology.

1. Additive fixatives (Crosslinking fixatives); By forming cross-links between proteins, it connects the cells and tissue components that make up the tissue, and provides protection as a whole with its form in the living thing. It also fixes and inactivates enzymes in the cytosol. However, this process takes time as tissue penetration and infiltration and bond formation takes place. However, it is the most successful fixation technique to preserve tissue integrity.

Ex; Aldehydes (Formaldehyde, Gluteraldehyde)

2. Non additive fixatives (Coagulative fixatives); It protects tissues by coagulating and precipitating proteins, fixing them in position. However, it is not as successful as fixatives that form crosslinks in preserving tissue integrity during long-term procedures such as tissue follow-up. Fixation is completed in a short time. Therefore, it is preferred for fixation of frozen tissue sections and cytological smears.(2,4,10,11,12,13)

Ex; Alcohol (Ethanol, methanol, acetone)

Tissues that are preserved in their living condition by the fixation process will then be taken into the tissue processing process.

2. 4. Decalcification

It is known that each tissue that comes in the pathology routine has its own characteristics. Particularly, cutting hard tissues such as bone so that they can be examined under a microscope creates a significant problem, because it is not possible to fix hard tissues such as bone, teeth to cut thinly with our microtome blades.

Bone tissue is an active living tissue in which continuous production and destruction events take place. While its protein-weighted matrix and osteocytes

actively contribute to the metabolism of living things with osteoclast cells, it hardens with the Ca^{++} ions stored in its matrix, thus gaining a protective structure for body shape, movement and vital organs.

It is the attachment of calcium hydroxy apatite crystals on the collagen fibers that gives the bone its hardness. In order to evaluate the bone tissue and bone pathologies, it is necessary to remove the Ca^{++} ion from the bone and soften the bone tissue. The process of removing Ca^{++} ions from the bone is called the decalcification process.

Decalcification process in pathology is carried out with organic mineral acids and chelator chemicals. However, since these chemicals, especially acids, can damage living cells and molecules, bone tissue must be fixed before decalcification in order to protect living structures. Since bone is a hard tissue, the waiting time in fixatives and decalcification chemicals is quite long. For this reason, bone biopsies should be reduced to the maximum size according to the characteristics of the lesion area and left to fixation and decalcification solutions. Unfixed and non-reduced bone should never be placed in the decal solution. When the bone is cut for reduction, a preview can be made by preparing an imprint preparation from the biopsy core before it is fixed. Imprint preparation is a process that allows the cells separated during cutting to be transferred to the slide easily by touching the slide to the lesion surface.

It is waited until the bone softens by checking the decal solution and renewing the solutions daily. When the bone is softened, the tissues that are removed from the decal and washed can be cassetted for tissue follow-up. (14,17, 18, 19, 21, 22)

2. 5. Tissue Processing

The purpose of tissue processing is to ensure that the tissue we protect with a correct fixation process is taken without compromising its structural integrity during blocking and thin sectioning in the microtome. As we know, our tissues contain a large amount of water. The purpose of tissue processing, which is one of the most important steps of histotechnology, is to remove the water in the cell from the cell and place a hardening chemical inside the cells and tissues. It should be known that the chemicals chosen during the follow-up process, the interaction of the tissue with these chemicals and the duration of interaction are very important for the structural protection of the tissues. Our goal is to remove the water in the tissue and place a hardening chemical in the tissue, otherwise the soft tissue may be structurally dispersed during the sectioning process.

In order for one liquid to be chemically replaced by another, the two liquids must have the ability to mix with each other. This is closely related to the chemical properties of liquids. The liquids to be used in the tissue processing are liquids that have the property of mixing with each other in accordance with our purpose.

Tissue processing; It is the name of the sequence of operations that starts with the fixation of the tissue and goes until the tissue is ready to be embedded in paraffin.

The tissue processing steps can be listed as follows;

- Fixation
- Dehydration
- Transparency
- Infiltration

Dehydration:

Dehydration, which is the first stage of tissue processing, means the removal of water. In short, it is the removal of "free" unbound water and aqueous fixatives from tissue components. Why is dehydration necessary? Because the chemicals we use to harden the tissue are apolar chemicals (such as paraffin, celloidin), they do not interact with water, cannot mix with each other, cannot enter into the tissue and fulfill the function of hardening the tissue.

There are many dehydrating agents.

The chemicals used for dehydration are mostly alcohols. Alcohols are compounds formed by adding a -OH to hydrocarbons (CnH2n+1-OH).3 Pure alcohols, which we call absolute alcohol, generally contain 2-3% water. Alcohols are polar compounds.

Dehydration usually; Chemicals such as Ethyl Alcohol (C2H5OH), Denatured Alcohol, Methanol (CH3OH), Isopropyl Alcohol/Isopropanol (CH3CHOCH3H), Acetone, Dioxane, Tertiary Butanol, Tetrahydrofuran can be used.

Ethanol is a transparent, colorless flammable liquid. It is hydrophilic and therefore can be mixed with water and many organic solvents in varying proportions. It is a fast-acting and safe solution, so it is the most commonly used alcohol for dehydration. Knowing that long-term absolute alcohol dehydration will also cause shrinkage and hardening of the tissue, attention should be paid to the duration of the tissue in absolute alcohol.

Transparency:

These chemicals are solutions that act as a mediator between dehydration and infiltration solutions. They must be miscible with both solutions. As we mentioned before, some chemical properties are important for the two solutions to mix with each other. It is important whether the chemical is polar (polar) or nonpolar (non-polar). Some solvent molecules can exhibit polarity and nonpolarity properties together.3 For example, ethyl alcohol is such a molecule. One end of the molecule is polar and the other end is nonpolar. Therefore, ethyl alcohol is a good solvent for both polar (water) and nonpolar (xylene) substances.

Clearing chemicals should be miscible with the dehydrating agent, which is mostly ethyl alcohol, and the infiltration medium, which is mostly paraffin. Their purpose is to remove the alcohol used for dehydration and to prepare the infiltration medium for the tissue space-retaining paraffin.

Most cleaning agents are flammable liquids that require caution in their use. Environmental considerations must be taken into account, as most cleaning agents are aromatic hydrocarbons or short-chain aliphatic hydrocarbons.

Cleaning agents suitable for routine use; Xylene, Toluene, Chloroform, Citrus Oils - Limonene Reagents.

Xylene, which is one of the chemicals that has the feature of cleaning alcohol, is the most used cleaning agent and although there are other cleaning chemicals, very few of them are accepted. Xylene is a characteristic aromatic hydrocarbon, a flammable, colorless liquid with a pungent odor, miscible with most organic solvents and paraffin wax. Suitable for cleaning blocks by quickly removing alcohol from tissue. Xylene is a flammable reagent and is considered a hazardous substance, so waste solutions must be recycled or disposed of using special techniques.

Infiltration:

After the dehydration and transparency stages, the tissues are enclosed in a supportive environment. In this environment, it replaces the transparent chemical supporting substance in the tissues. This process is called infiltration or impregnation. The rule of “like dissolves like” is a very important rule for two chemicals to mix with each other. Compounds with similar molecular structure dissolve each other because they have close intermolecular forces.3 Compounds with dissimilar structures do not tend to form solutions. For this reason, organic aromatic hydrocarbon compounds (xylene, toluene, etc.) and saturated hydrocarbon compounds (paraffin, etc.).

Substances used in infiltration and embedding: Paraffin, Resin, Agar, Cellloidin, Gelatin

Paraffin wax remains the most popular filling (infiltration) and embedding medium in histopathology laboratories. Paraffin wax is a mixture of long chain hydrocarbons. Its properties vary between 47°C -64°C depending on the melting point used. Paraffin penetrates the tissue in liquid form and solidifies rapidly when cooled. Thus, the paraffin displaced by the cellular fluid morphologically prevents the deformation of all cellular and tissue integrity components and prepares it for thin sections to be taken.

The basic principle of tissue tracking; It is based on the principle of keeping the tissues in suitable solutions for certain periods and replacing the solutions with the fluids in the tissue.

For this purpose, tissue processing is carried out in three main ways;

1- Manual tissue processing
2- Tissue processing with automated devices
3- Microwave processing

No matter which method is used, the common feature of all of them requires that the tissues be kept in suitable solutions for certain periods. Important points to know;

- Tissues should be kept in three separate containers for each solution for at least 30 minutes – 60 minutes. Since the cellular fluid and chemicals are displaced, it is necessary to ensure complete cleaning in the last container, taking into account the contamination in each solution.
- Solutions should be 50 times greater than the volume of the tissues. It is necessary for complete infiltration of tissues.
- Since heat increases molecular mobility, it should be known that as the temperature increases, the residence time in the chemical can be shortened.
- It should be known that devices with vacuum application are more suitable for successful infiltration in order for the paraffin infiltration with high density to be complete.

The comfortable implementation of all these conditions, the automatic correct execution of the long-lasting process independently of people, the special discharge of toxic gases, and the prevention of gas contamination in the

ambient air have been made possible by the use of automated tissue tracking devices. Today, follow-up processes are generally carried out with automated tissue tracking devices. When using the device, it is important to check the cleanliness, amount and temperature of paraffin solutions before installing the device.(2,3,4, 6,7, 14)

2. 6. Tissue Blocking (Embedding):

Tissue processing is a sequence of operations applied to ensure smooth thin sectioning without causing deformity from finished tissues. In the tissue processing process, although there is a substance (paraffin) that we send as a hardener and placeholder into the tissue section of 3-4 mm thickness that we placed in the tissue processing cassette, in order to cut such a small tissue in the correct position and properly, the liquid, while still hot, solidifies when it cools. we need to use a medium that will support the tissue. Paraffin, which we usually use for infiltration in tissue processing, is suitable for this procedure For blocking or embedding, a device called paraffin dispenser is required to keep the paraffin in liquid form. The melting point of the paraffin we use in blocking is between 56 ^{o}C -60^{o}C. We need molten paraffin for blocking. In addition, a hot chamber with a temperature of 10^{o}C less than the melting point of paraffin is needed in order to prevent sudden cooling of the tissues coming out of the tissue processing. The tissues coming out of the tissue processing are kept in this chamber and taken to the embedding process one by one. The reason for this is that the paraffin we send into the tissue is taken into the blocking process before it cools down and loses its flexibility. The aim is to prevent fractures that may occur in the tissue with the pressure applied to the cooled paraffin while placing the tissue into the block.

Metal or plastic blocking molds are used for blocking. Considering the possibility of plastic stretching from heat, mostly metal blocking molds are used (base mold).

In the tissues whose blocking process is completed, it is important that the paraffin be cooled immediately, so an important part of the blocking is the cold plate or cold chamber..

The most important issue in the blocking process is the correct orientation to the tissue. The features of the sectioned tissue should be well known and these features should be taken into account when placing them in the block. How the texture should be placed in the block is a process that requires special knowledge and experience. The surface that is desired to be seen during the

section is placed on the bottom. Again, after the tissue is placed in hot paraffin, it should be pressed lightly so that it fits snugly to the bottom of the block. Otherwise, it will not be possible to take the entire surface section at the same time, even if there is a minimal level difference.

Things to consider in blocking;

— The tissue must be fully seated on the base of the block

— To prevent the hard tissues from compressing the softer tissues below and to ensure smoother sections, the tissue should be placed in a way that allows the blade to move from the region of less resistance to the region of greater resistance when sectioning.

— The features of the parts to be buried must be known individually!

— Tissues with skin or epithelial surfaces should be embedded in such a way that the skin ellipse is visible and the epithelial surface points in the same direction.

— Lumened (tubular) tissues should be embedded so that the lumen is visible on the section

— After embedding the tissues, paraffin should be cooled quickly.

An error in the blocking process will directly affect the correct evaluation. If tissues with epithelial surfaces and tubular tissues are not embedded correctly, an epithelial tumor may be missed and the presence of invasion may not be observed. This causes serious diagnostic errors. If the tissue is not cooled rapidly, changes in the crystal structure may cause artefacts in the section, and the tissue may come out of the block while sectioning. For this reason, the blocking process should be done by people with special knowledge and skills. (2, 4, 20, 23)

2.7. Sectioning

It is the process of taking thin sections from the tissues that have completed the blocking process so that they can be seen under the light microscope.

In order to view them under an operating microscope, sections thin enough to transmit light are needed. It aims to take sections by embedding in a hardened and hardening medium that is fixed until the sectioning process, without deteriorating the out-of-frame morphology.

Special devices called microtomes are used to cut the tissues by 0.5-60 μ.

Although there are many types, Rotary microtomes are routinely used in pathology laboratories for thin and serial sectioning. The blades used in microtomes are very sharp special blades. Disposable blades (disposable blades) are the most commonly used blade type in these microtomes today. The cross-section quality of these knives is quite high. They are made of stainless steel. Those with blades covered with platinum and chrome are used for cutting paraffin embedded tissues, while those with Teflon blades are used for frozen tissue sections.

The blocks that harden on the cold plate are placed in the block holder of the microtome, the blade is attached, the block blade angle is adjusted. First, the paraffin, which is a thin layer on the tissue, is shaved with a process called shaving until the entire surface of the tissue is visible. Then, thin sections are started to be taken by adjusting the section thickness according to the tissue feature.

The thin sections taken are thrown into the tissue water bath so that they can be transferred to the slide properly. The tissue water bath has a thermostat feature that is 10 degrees lower than the melting point of paraffin and has a temperature of about 45oC in order to prevent the disintegration of the sections. The water used should be distilled water. If the water bath is cold; Since thin sections contain paraffin, breaks can be seen in the tissue that has lost its flexibility while being transferred to the slide. This point is important for smooth transfer of the section to the slide.

By immersing the slides in the water bath, the sections opened in the water bath can be easily transferred to the slide.

The use of microtome is a process that requires dexterity and knowledge and is one of the most important steps of histotechnology.(2, 4,20,23)

2.8. Deparaffinization

It is the process of removing paraffin from the tissues whose sectioning process has been completed before the staining process. In tissue follow-up, it was sent into the tissue and hardened the tissue. After ensuring that the section is taken properly and the section is taken on a slide, there is no longer any need for paraffin and it must be removed from the tissue. Most of the tissue dyes are incompatible with paraffin due to their content and paraffin prevents the staining process in the tissue. For this reason, we first leave the paraffin at a temperature slightly higher than its melting point and let the paraffin flow through the tissue. For this purpose, we keep the prebarats in an oven at 70oC for about 1-2 hours.

Then, we soak it in two xylene solutions for 10 minutes to clean the remaining paraffin residues. In order to remove the xylene from the tissue and return the tissue to its original format, we complete the deparaffinization process by spending 10 minutes in the 97% alcohol container in two different containers. It has been possible to apply all these conditions comfortably, to carry out the long-lasting process in an automatic manner independently of people, to prevent gas contamination to the ambient air by providing a special discharge of toxic gases, by the use of automated tissue tracking devices. Today, follow-up processes are generally carried out with automated tissue tracking devices. When using the device, it is important to check the cleanliness, amount and temperature of paraffin solutions before installing the device.(2,4,7, 20,24)

2.9. Staining

Our tissues and cells (with the exception of erythrocytes and some pigment-containing cells) are transparent and colorless. In order to evaluate cells and tissues morphologically under the light microscope, we must first distinguish the nucleus and cytoplasm of the cell, which is the smallest unit of life. Tissues are collections of cells that come together to perform a similar task.

Based on this fact, we will first need to be able to distinguish the nucleus and cytoplasm of the cells. In addition to staining cells, it is necessary to be able to see structures that are in close relationship with other tissues, fill the spaces between cells, and form the intermediates of supporting tissues such as connective tissue, in order to interpret the relationships of these tissues with each other in a meaningful way. We achieve all these processes with cell and tissue dyes in histotechnology.

Hematoxylin & Eosin stain is the general tissue stain we use in the histotechnology routine. It is used to separate the nucleus and cytoplasm. Hematoxylin usually stains different parts of the tissue in different colors; intranuclear staining of the nucleus blue-black

Shows the detail well. Eosin stains the cell cytoplasm and connective tissue elements in various variations pink, orange and red.(2, 4, 8, 24, 25,26,27,28)

2.10. Mounting

After deparaffinization and staining, the tissues that are sectioned and transferred to the slide are covered with a coverslip by applying sealants on the slide and become ready for microscopic examination. This process is called the mounting process.

The mounting process protects the tissue transferred onto the slide from moisture, heat and physical damage. In addition, if the refractive index is appropriate, it allows the tissue to get closer and more visible under the microscope. For this reason, the concealer to be chosen should be slightly below or slightly above the refractive index of the tissue. In addition, the preparations closed with the mounting process can be stored and archived for years without deterioration.

Correct application of the mounting process within its application area is necessary for a clear examination under the microscope.(2,4,8,24)

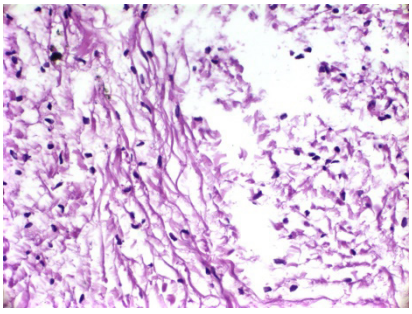


Figure 1. Fixation defect

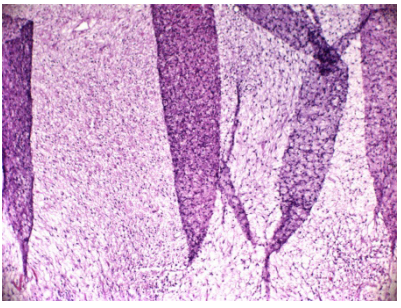


Figure 2. Wrong section

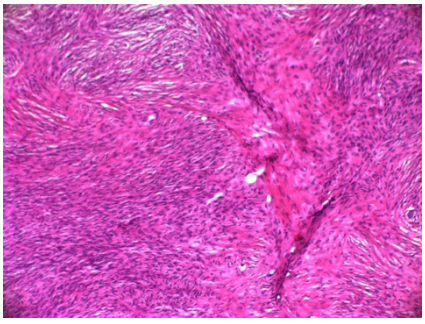


Figure 3. Thick section, staining error

As can be seen, the analytical process for a tissue to be examined under a microscope after its removal is quite complex and requires the correct application of a series of successive steps. It is clearly seen that these stages, which are the continuation of each other, require special knowledge and skills, and that any mistake or incomplete application in any of the stages will ultimately negatively affect the microscopic evaluation of the tissue. This may prevent or delay obtaining a clear image, which is necessary for a healthy and accurate diagnosis.

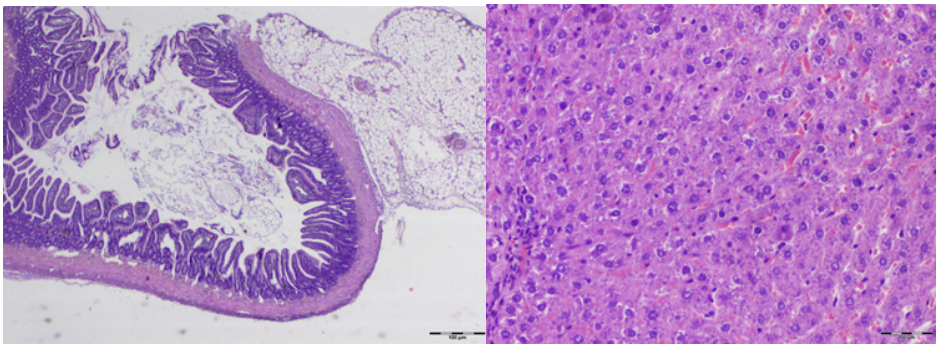


Figure 4. Correctly prepared tissues

3. Results

Correct diagnosis is closely related to correct preparation. Accurate diagnosis is the main goal of histopathology. The microscopic changes observed on the tissues of diseases such as infection, inflammation, different infectious microorganisms, benign tumors and cancer are also different. Sometimes, even if the patient has no clinical symptoms, microscopic evaluation makes important contributions to diagnosis and treatment. In addition, in research studies conducted to examine the effects of some chemicals and drugs on tissue, it supports scientific developments by providing the right technique, accurate evaluation and results.(29,30). To be able to comment on this subject, examining and interpreting the changes in tissue structure and individual cells is possible as a result of microscopic evaluations of pathologists and specialist physicians trained in this field. In the pathology laboratory, which works as a process, first of all, error-free and prepared microscopic slides are needed for accurate evaluation techniques.

In the light of all these evaluations, the importance of pathology laboratory techniques and trained technical team in this field with special knowledge and skills is increasingly recognized in the field of pathology. In particular, the importance of new techniques developing day by day for diagnosis is increasing. Successful application of new techniques is closely related to the correct execution of general histopathological procedures. Since the samples coming to the pathology laboratory are usually removed by surgical procedures, it is often impossible to take samples again in case of damage to the sample. This situation increases the importance of correct technical applications even more.

References

1. Doğan Ö, Ahıskalı R, Çakalağaoğlu F, Özkan N, Ekicioğlu G, Şalva E, et al. Patolojide Temel Histopatolojik Laboratuar Teknikleri [Basic Histopathological Laboratory Techniques in Pathology] İstanbul: Türk Patoloji Derneği Meslek İçi Eğitim Kursu; 2004.

2. Bancroft JD, Gamble M. Theory and Practice of Histological Techniques. 6th ed. USA: Elsevier; 2008.

3. Petrucci RH, Herring FG, Madurra JD, Bissonette C. çeviri; uyar T, Aksoy S, İnam R. Genel Kimya İlkeler ve Modern uygulamalar Moleküller arası kuvvetler: Sıvılar ve Katılar [General Chemistry Principles and Modern applications Intermolecular forces: Liquids and Solids] 10. Baskı. Ankara: Palme Yayıncılık; 2012.

4. Carson FL, Hladik C. Histotechnology. 3rd ed. Cicago: ASCP Press; 2009.

5. Çakaloğlu F. Patoloji Laboratuvar Teknikleri ve Laboratuvar Yönetimi. [Pathology Laboratory Techniques and Laboratory Management] Kongre Kitapevi; 2019

6. Çakalağaoğlu F. Doku takibi [Tissue processing] Aegean Pathology Journal ulusal Patoloji Sempozyumu. 2005;2(2):29-34.

7. Sandeep Kumar. Histopathology Techniques https://www.academia.edu/30539908/Histopathology_techniques. Accessed March 2023

8. Ahmed, I.E.M.. Lecture notes on : Routine Histological Techniques. University of EI-Imam EI-Mahdi, Kosti. , 2015

9. Usubütün A. Makroskopik değerlendirmede temel prensipler.[Basic principles in macroscopic evaluation] Erdoğan N, editör. Histoteknoloji. 1. Baskı. Ankara: Türkiye Klinikleri; 2021. p.10-8

10. Titford, Michael E., and Marcelo G. Horenstein. "Histomorphologic assessment of formalin substitute fixatives for diagnostic surgical pathology." Archives of pathology & laboratory medicine. 2005; 129.4 , 502-506.

11. Bhat, Ashaq Hussain, and Samiea Hussein.(2021) Fixation and different types of fixatives: Their role and functions: A review. *Int. J. Clin. Diagn*. Pathol ; 4, 113-119.

12. Sampedro-Carrillo, Enrique Agustín. "Sample preparation and fixation for histology and pathology." Immunohistochemistry and Immunocytochemistry: Methods and Protocols. 2022; 33-45.

13. Doğan İÖ.(2021) Doku fiksasyonu ve formaldehit kullanımı.[Tissue fixation and use of formaldehyde] Erdoğan N, editör. Histoteknoloji. 1. Baskı. Ankara: *Türkiye Klinikleri;*.1-9.

14. Sezgin Y.(2021) Doku takibi. [Tissue processing] Erdoğan N, editör. Histoteknoloji. 1. Baskı. Ankara: *Türkiye Klinikleri*; 19-31.

15. Rohr RL, Layfield LJ, Wallin D, Hardy D.(2001) A Comparison of Routine and Rapid Microwave Tissue Processing in a Surgical Pathology Laboratory. *Am J Clin Pathol*;115:703-8.

16. Farrell S, Osmotherly P, Peter G, Rivett D, et al.(2015) Formic acid demineralization does not affect the morphometry of cervical zygapophyseal joint meniscoids. *Anatomical Science International*;90(1):57- 63.

17. Eroschenko V.P. çeviri; Ramazan Demir. İskelet Dokusu: Kıkırdak ve Kemik. diFiore Histoloji Atlası 12. Baskı. Ankara: Palme Yayıncılık; 2016.

18. Haixia L, Ruyuan Z, Chenyue L, Rufeng M, Lili W, Beibei C, et al. Evaluation of Decalcification Techniques for Rat Femurs using HE and Immunohistochemical Staining Research Article | Open Access. 2017; Article ıD 9050754 https://doi.org/10.1155/2017/9050754

19. Pradhan P, Rajesh NG, Badhe BA, Ilanchezian K, Manimehalai D, Jyothish A.(2019) A novel approach to decalcification in histopathology laboratory: An adaptation from the Hammer smith protocol. *Indian J Pathol Microbiol* ;62:423-9.

20. Prophet EB, Mills B, Arrington JB, Sobin LH. Laboratory Methods in Histotechnology. Washington: Armed Forces ınstitute of Pathology& American Registry of Pathology; 1992.

21. Wisanuyotin T, Mitchai J, Sirichativapee W, et al.(2009) Tissue imprint for intra-operative evaluation of musculoskeletal tumors. Journal of the Medical Association of Thailand;92:654-9.

22. Savi F, Brierly G, Baldwin J, et al.(2017) Comparison of Different Decalcification Methods using Rat Mandibles as a Model. Journal of Histochemistry and Cytochemistry;65(12):705

23. Yılmaz F. Bloklama ve kesit alma.[Blocking and sectioning] Erdoğan N, editör. Histoteknoloji. 1. Baskı. Ankara: *Türkiye Klinikleri;* .50-60.

24. Yörükoğlu K. Nükleer ve sitoplazmik boyama: rutin hematoksilen+eosin. [Nuclear and cytoplasmic staining: routine hematoxylin+eosin.] Erdoğan N, editör. Histoteknoloji. 1. Baskı. Ankara: Türkiye Klinikleri; 2021. p.61-5

25. Tosta, Thaína A. Azevedo, et al.(2019) Computational normalization of H&E-stained histological images: Progress, challenges and future potential. *Artificial İntelligence İn Medicine;* 95, 118-132.

26. Wick, Mark R. The hematoxylin and eosin stain in anatomic pathology—An often-neglected focus of quality assurance in the laboratory. Seminars in diagnostic pathology. Vol. 36. No. 5. WB Saunders, 2019.

27. Bai, Bijie, et al. Deep learning-enabled virtual histological staining of biological samples. Light: Science & Applications. 2023; 12.1, 57.

28. Jeong, Mi Kyung, and Bae-Hwan Kim. (2022) "Grading criteria of histopathological evaluation in BCOP assay by various staining methods." Toxicological Research, 38.1, 9-17

29. Güven A, Nur G, Deveci HA (2019) The Effects of Green tea (Camellia sinensis L.) and Parsley (Petroselinum crispum) Diets on the Activities of GSH-Px, GST, CAT, GSH and LPO Levels in Mice Tissues. Parlar Scientiific publications, 28(9):6521-6527.

30. Güven A, Güven A, Gülmez M.(2003) The Effect of Kefir on the Activities of GSH-Px, GST, CAT, GSH and LPO Levels in Carbon tetrachloride-Induced Mice Tissues. *J. Vet. Med. B 50,* 50(1):412-416.

CHAPTER VIII

BONE MORPHOLOGY

Esin ÖZŞAHİN

(Asst. Prof. Dr.), Baskent University Faculty of Medicine
Department of Anatomy, ozsahine@gmail.com,
ORCID: 0000-0001-6506-1507

1. Introduction

Bone forms the most important structure of the adult skeleton. It supports the structures made up of soft tissue. It protects vital organs that are present in skull and thorax spaces. It is the main source of bone marrow where the blood cells are made. Besides, it helps controlled release or storage of calcium phospate and other anions to keep their blood levels in constant amounts. In addition to these functions, it conjures a leverage system and by augmenting the forces derived by the striated muscles turns them into physical movements (1,2).

Bone tissue is a cellular structure which has multiple mechanic and physiologic functions and is surrounded by an intrasellular, solid and a calcified frame. Together with its supportive and protective functions, it is the hardest specialized connective tissue of the body (3) .Bone is a special connective tissue. The substance called Bone Matrix is an intercellular calcified material. It involves three type of cells. These are osteocytes placed in the cavities of the matrix called lacuna, osteoblasts which synthesizes the organic structure of the matrix and osteoclasts which are giant cells wih multiple nucleus which providing the the rezorbtion and remodelling of the bone tissue (2-5) .

Metabolytes cant pass from the bone matrix with diffusion, therfore substance transport between osteocytes and the blood capillaries are supplied by way of the cellular transport in channels which drill the matrix thin and cylindirically. All bones are covered with membranes called endosteum in inner surfaces and periosteum in outer surfaces which have osteogenic cells. Bone cannot be choped directly with the microtome, Two different methods are

used where the bones are decalcified or not to obtain section with mycrotom. Besides abrasion technique is used for studies on the bone.(6)The adult human skeleton has a total of 213 bones, excluding the sesamoid bones. The appendicular skeleton has 126 bones, axial skeleton 74 bones, and auditory ossicles six bones. Each bone constantly undergoes modeling during life to help it adapt to changing biomechanical forces, as well as remodeling to remove old, microdamaged bone and replace it with new, mechanically stronger bone to help preserve bone strength. The four general categories of bones are long bones, short bones, flat bones, and irregular bones. Long bones include the clavicles, humeri, radii, ulnae, metacarpals, femurs, tibiae, fibulae, metatarsals, and phalanges. Short bones include the carpal and tarsal bones, patellae, and sesamoid bones. Flat bones include the skull, mandible, scapulae, sternum, and ribs. Irregular bones include the vertebrae, sacrum, coccyx, and hyoid bone. Flat bones form by membranous bone formation, whereas long bones are formed by a combination of endochondral and membranous bone formation. The skeleton serves a variety of functions (1-6).The long bones are composed of a hollow shaft, or diaphysis; flared, composed primarily of dense cortical bone, whereas the metaphysis and epiphysis are composed of trabecular meshwork bone surrounded by a relatively thin shell of dense cortical bone. The adult human skeleton is composed of 80% cortical bone and 20% trabecular bone overall (1-7) . Different bones and skeletal sites within bones have different ratios of cortical to trabecular bone. The vertebra is composed of cortical to trabecular bone in a ratio of 25:75. This ratio is 50:50 in the femoral head and 95:5 in the radial diaphysis. Cortical bone is dense and solid and surrounds the marrow space, whereas trabecular bone is composed of a honeycomblike network of trabecular plates and rods interspersed in the bone marrow compartment. Both cortical and trabecular bone are composed of osteons. Cortical osteons are called Haversian systems. Haversian systems are cylindrical in shape, are approximately 400 mm long and 200 mm wide at their base, and form a branching network within the cortical bone (3-7).

2. Bone Cells

2.1. Osteoblastlar

Osteoblasts are responsible for the synthesis of the organic compounds of the bone matrix (type 1 collagen, proteoglycans and glicoproteins). The formation of the inorganic parts of the bone depends on the presence of live

osteoblasts. Osteoblasts take place on the bone surfaces next to each other resembling epitelium cell. Their shape can change from cubic to prismatic when they start matrix syntesis. Alkalen phopahtase activity increases and stoplasm becomes basofilic. As the synthesis decreases, they get flat, and their basofilic properties decrease too. Osteoblasts have cytoplasmic extentions to supply connection with adjacent osteoblasts. These extentions become more visible when the cell starts to surround itself with matrix. When surrounded with the newly synthesized matrix osteoblasts are now called osteocyt. The formation of matrix between the cell and its cytoplasmic extentions, makes the lacuna and canallets evident.

During matrix syntesis, osteoblasts are like cells that make active protein synthesis and secretion. Matrix secretion takes place from the osteoblast surfaces that is in touch with the previously formed bone matrix. Hence; between the osteoblasts and previously formed bone matrix, uncalcified matrix takes place. This is called the bone aposition and it ends in time with calcium cloride settling (4).

2.2. Osteocytes

Osteocytes which are formed from osteoblasts are placed in the lacuna between matris lamels. Each lacuna has only one osteocyte. Cytoplasmic extentions of osteocytes are surrounded with thin, cylinderic matrix channelets Adjacent osteocytes get in touch with each other with the cellular connections derived from the ctyoplasmic extentions and let the nutrients pass from one cell to another. The exchange of some molecules between osteocytes and blood vessels also happen by the small amount of extracellular substance that is present between osteocytes and bone matrix. This exchange can provide support for almost 15 cell osteocyte chain.

Osteocytes when compared to osteoblasts are flat and eliptic. Their endoplasmic reticulum and Golgi complex are strikingly small. Core chromatin is denser. These cells take active role for the continuity of the bone matrix. Osteositlerin Matrix resorbtion takes place after osteocytes come to the end of their lives (4,8) .

2.3. Osteoclasts

Osteoclasts are very large and show advanced branching. In the wide part of the cell body they have 5-50 (or more) nucleus. The branches of the cells

display irregularity and different shaping. These cells are found the in the pits named Howship lacuna formed enzimatically in sites where bone resorbtion starts. Since they are formed by the unity of the monocytes that are derived from blood, osteoclasts take place in mononuclear phagocytic system.

The sitoplasm of thin osteoclasts are generally asidophilic. In active osteoclasts the face that sees the bone matrix generally fold irregularly and form a brushy edge. Around the brushy edge, there is a cytoplasmic region (transparent region) which has no organels. This site is rich by actin flaments. This is the site that ostoclast is bound to bone matrix and forms the micro environment for bone resorbtion. In the cell, together with the multiple lyzozomes there is granular endoplasmic reticulum, plenty mithocondria and a well developed Golgi complex. Calcium containing cristals, are seen between folds as well as in cytoplasmic vacuoles. These vacuoles are possibly originated from the surface membranes of osteoclasts. It has also been reported that, collagen fibriles in the extracellular regions seperate from each other. But all these events never take place in the cytoplasm of the cell. Osteoclasts secrete acid, collogenase and other proteolytic enzymes that effect the bone matrix. Therefore they free the calcified basal substance and play active role in the elimination of waste products that come up during bone resorption (4,7) .

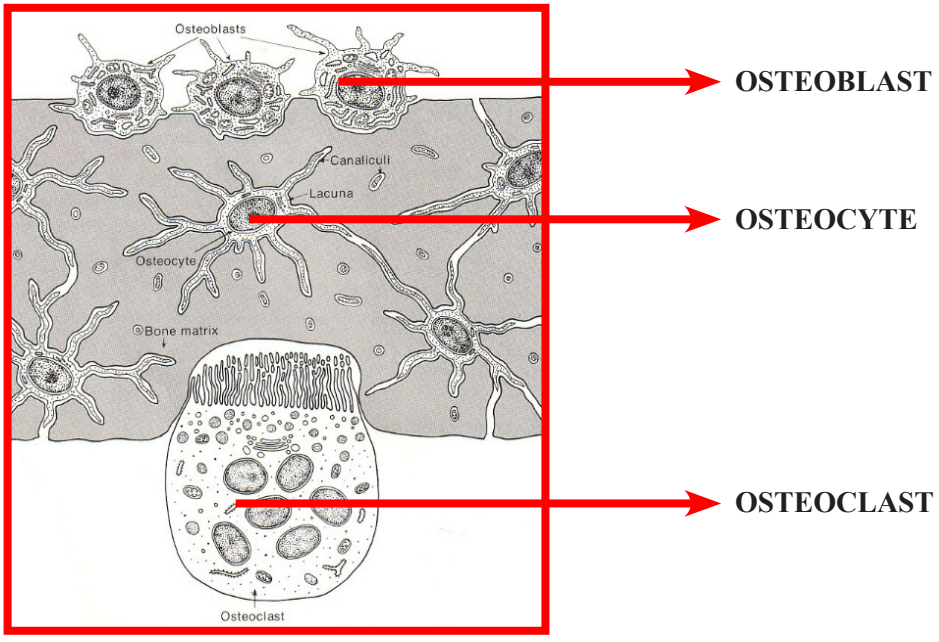


Figure 2.1. Bone tissue cells.

3. Bone Matrix

Inorganic substances make up of 50% percent of the dry weight of the bone. Its content is rich from calcium and phospate. Besides, there is also citrate, magnesium, potassium and sodium. Studies undertaken with x-ray defraction method have shown that, calcium and phosphate come together in Ca10 (PO4)6 (OH) 2 composition to form hydroxyapatite crystals. There are also high amounts of non amorf cristal calcium phosphate here. Bone hydroxyapatite crystals are seen in 40x25x3 nm in form of plates with electron micrographs. They are found beside the collogen fibres and surrounded with amorf substance. Since the ions on the surface of hydroxyapatite have enough water, the crystal is surrounded by a layer formed of water and ions. This layer is called the Hidration Shell and it facilitates the ion transport between body fluids and the cristal. Organic substance consists of amorf basic material which contains precipitates of type 1 collogan and proteglicans.

Bone cyaloprotein (rich from cialic acid) and osteocalcin contain a few γ-carboxysiglutamic acid residues that help them form a thight connection to the calcium and which is probably the initiating factor of the calcification of bone matrix.

Normally type 1 collagen containing other tissues don't get calcified and don't contain proteins. Bone getting decalcified because of rich collagen gets darker with collagen paints.

The relation between hydroxiapatite and collagen fibres is responsible of hardness and endurance of the bone. After being decalcified, bone preserves its shape but becomes as flexible as tendons. The removal of the organic parts of the matrix which consists largely of collagen does not change the shape of the bone but makes it fragile to be broken easily (4,7).

Periosteum and Endosteum

The outer and inner surfaces of the bone are covered with layers consisting of cells that maket he bone and connective tissue. Outer one is called periosteum, inner one is called endosteum. The outer layer of Periosteum consists of collagen fibres and fibroblasts. Sharpey fibres consisting of periostal collagen fibres enter the matrix and ties the periost to the bone. The inner layer of periosteum that is rich by cells is also rich by flat cells which have the potential to divide and form osteoblasts by differentiation. These osteoprogenitor cells are specialized by their location, flat shape, very low amount of granular endoplasmic reticulum

and poorly developed golgi complexes. Autoradiographic studies show that these cells intake 3H-Thymidine and that substance is also seen in osteoblasts afterwards. These cells play premier role in the growth and the repairment of the bone.

Endosteum covers all the spaces in the bone and consists of osteoprogenitor cells and very low amount of connective tissue. Therefore endosteum is much thinner than periosteum. The main function of periosteum and endosteum is to continously supply the new osteoblasts needed for the nutrition and growth of the bone tissue. Therefore in bone surgery, the protection of periosteum and endosteum is very important.

4. Bone Types

The microscopic detection of the bone has revealed two types of bones. Primary, unmatured, or bone with coarse fibers and secondary, matured or lamellar bone. Primary bone is the type of bone that comes out first for recovery procedures for fractures and other reasons in the embriologic development period. Contrary to the lamellar form of the secondary bone, primary bone displays thin collegen fibres being distributed in various directions.

When bone sections are examined roughly, it is seen that, dense areas with no space in between make up the compact bone, whereas multiple areas with spaces form the spongious bone. But the histologic formation of trabeculi that separate the spaces either in the compact bone or in the spongious bone are the same. The swollen tips of long bones are called Epiphys. Epiphyses consist of spongious bone convered with a thin compact bone. The cylindric part, called the diaphysis, is totally made up of compact bone, with very little spongious bone on the surfaces seeing bone marrow spaces. Most often, the spongious bone in the center of short bones are totally covered with compact bone. Flat bones that form the skull have two layers of compact bone separated with a spongious bone layer called diploe. The bone spaces in the diaphysis of the spongious bone and the long bones are filled with two types of bone marrow 7,8. One of them is the red bone marrow formed by the blood cells, and the other is yellow bone marrow mostly formed by fat cells (8,9).

4.1. Primary Bone Tissue:

The first bone tissue that appears is the primary bone. It is permanent and except some places like flat bone articulations, tooth alveoli and sites where

tendons detach the bones, they leave their place to secondary bone. Compared to the secondary bone tissue, primary bone tissue contains less minerals to go with randomly distributed collagenous fibres (X- rays pass easier) and more osteocytes.

4.2. Secondary Bone Tissue:

Secondary bone tissue is generally seen in adults. Collagenous fibres typically organized in forms of lamels 3-7µm thick, parallel to each other or in a circulary way around a vascular channel. This composition formed by circulatory lamels that surround blood vessels, nerves and containing a loose connective tissue is called the Havers System or osteon. Lacunas which contain osteocyte can be found between the lamels and less often in them. Collogen fibers are parallel in every lamel. Every Havers system is surrounded by a glue like substance composed of a few collagen fibers, and mineralized amorf matrix. Lamels in the compact bones show a typical regulation like havers systems in the diaphysis of long bones, outer circular lamels, inner circular lamels and interstitial lamels. Each Havers system is a multy branching cylinder and is paralel to the long axis of diaphysis. It is formed of 4-20 circular lamels around a central channel. In every channel covered with Endosteum there are blood vessels, nerves and loose connective tissue. Havers channels set up connections with bone marrow spaces, periosteum and between each other by way of horizontal or oblique travelling Volkman Channels. Volkman channels do not have circular lamels. They drill the lamels. At first, the bone is formed by the precipitation of matrix around the present blood vessels. When detected under polarized light, Havers system is found to follow an alternative line with changing shiny anisotropic layers with dark isotropic layers. When detected under polarized light that is perpendicular to their long axis, collogen fibres are found to be double refracting (anisotropic). The alternating of shiny and dark layers depends on the rotation of the collagen fiber in the lamels. In every lamel, the fibres are parallel and travel in a spiral rotation. However, the opening of the spiral is different for every lamel. With this, the fibers of two adjacent lamels become perpendicular to each other. The diameter of the Havers channels are quite different. The lamels of all system are formed from outside to inside, therefore the channels of young systems are greater. In mature Havers systems, the newest lamel is the one nearest to the central channel. During the growing period and even in adult bone, Havers systems are continously broken down and rebuilt, therefore systems composed of only a huge central channel

and an few lamels can be seen. Interior and exterior circulatuar lamels, as it can be understood from the name are found around the bone marrow spaces and right beneath the periosteum. The lamels of these are located circulatory with the bone marrow space in the center. The number of outer circular lamels are greater that the number of inner circular lamels. There are multiple Havers systems between both circular systems. Between Havers systems, there are interstitiel or interim lamels, either in irregular groups or composed of parallel lamels. These are the lamels left behind from those, broken during growth and remodelling (4,7).

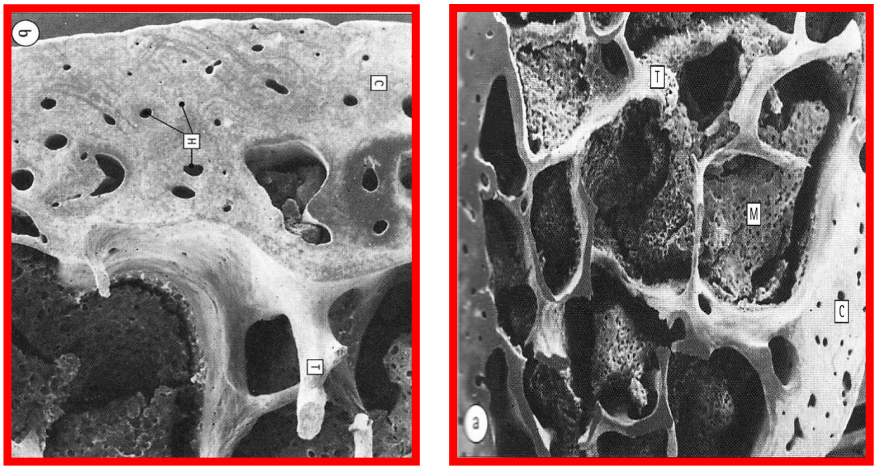


Figure 2.2. According to microscobic structure.
Compact bone (1), Spongious bone (2)

5. Histogenesis

Bone takes shape in two ways. Direct mineralization of the matrix secreted by osteoblasts (intramembranöz ossification) or the precipitation of the previously present cartilage matrix (endochondral ossification). In both ways, the first bone tissue is primary or immature bone tissue. Primary bone tissue is permanent. And shortly after that, it is replaced by secondary bone tissue (lamellar boneDuring the growing phase, primary bone areas, rezorbed areas and lamellar bone areas are next to each other. Bone synthesis and remodelling not only take part in growing bones but also continue in adults getting slower life long.

5.1. Intramembraneous Ossification:

Intramembraneous Ossification is the source of many flat bones and is given this name because it is formed in mesenchimal tissue concentration. All of the frontal and parietal bones, and some parts of the oxypital and temporal bones and mandibula and maxilla occur with intramembraneous ossification. Intramembraneous ossification plays a role in elongation of the short bones and thickening of the long bones. The first point where the ossification starts in the mesenchymal concentration is called primary ossification center. The process starts with a group of mesenchymal cells turning into osteoblasts. Calcification follows the formation of new bone matrix. As a result some osteoblast are surrounded and these cells become osteoblasts. These developing bone islands are named spicul after their images in histologic sections. Spicul is the section of walls that cover spaces like capillaries, bone marrow cells and undifferentiated cells. At the ossification center, almost simultaneously a few groups like this come out, and in time these come together to form the spongious structure. Bone marrow cells occur with a large number of undifferentiated mesencymal cells and cappilaries entering into the connective tissue between the bone spicules. The cells in the mesenchymal tissue concentration divide and form more osteoblasts to be responsible of the growing of ossification center. A few ossification centers replace the initial original connective tissue, after growing radially and getting united. Fontanelles in babies are an example of this. They are reciprocal to the soft areas of the skull made up of connective tissue and not yet ossified. Especially after birth, the inner and outer ossification of the flat bones of the skull gains superiority compared to bone destruction. Therefore 2 layers of compact bone (inner and outer layers) come up but the central part (diploe) maintains its spongious structures. The parts of the connective tissue that dont join the ossification form up the periosteum and endosteum of the intramembraneous bone.

5.2. Enchondral Ossification:

Enchondral ossification takes part in a small model formed of hyalen cartilage which resembles the outcoming bone. This type of ossification is responsible for shaping of short and long bones. Basically, enchondoral ossification has two phases. The first phase is the hypertrophy and the destruction of the condrocytes in the bone model. The remaining is the widened lacunas separated by cartilage matrix septums. In the second phase, the progenitor

cells and the remains of the osteogenic degenerated burgeon cells from blood cappilaries enter the region. Osteoprogenitor cells turn into osteoblasts that cover the cartilagenous septum with bone matrix. Thus; calcified cartilage tissue, supports the initiation of the ossification of the septums. Long bones are formed from hyalin cartilage models, which is composed of widened tips (Epiphysis) and a cylindiric body (Diaphysis). The first bone tissue to come out, is formed by way of intramembraneous ossification inside the pericondrium surrounding the diaphysis. Thus; a cylindiric bone layer occurs inside the perichondrium that surrounds the cartilage which is calle bone m. Since it surrounds the newly formed bone, the perichondrium is called periosteum. The condrocytes left behind in the newly formed bone m, get degenerated, lose their ability to supply the continuum of cartilage matrix, then calcium starts to precipitate and cartilage matrix gets calcified. The blood vessels of the osteogenic bud derived from periosteum enter the calcified matrix passing through the holes on the bone by osteoclasts. Besides blood vessels osteoprogenitor cells also enter this region. Osteoblasts start synthesising the bone matrix by forming a continous layer on the calcified cartilage matrix. Thus; primary bone synthesis starts on the calcified cartilage remains. Besides; the stem cells of the bone marrow in blood circulation are brought to the newly formed bone by osteogenic bud. In histologic sections, calcified cartilage can be distinguished from the bone tissue precipated on it basophically with acidophil components As the bone matris develops, calcified cartilage remains are eliminated by osteoclast like multy nuclear giant cells. This ossification center that occurs in the diaphysis is called primary ossification center. Rapid growing ends when diaphysis is ossified completelyThis widening of the primary bone center is accompanied by the widening of the periosteal bone circle towards epiphysis. Osteoclasts are active since the start of the ossification center and form thebone marrow space in the center of the bone with resorbtion. This space grows toward the epiphysis until the ossification of the model is completed. In advanced stages of the embrional development, secondary ossification centers take place in the middle of epiphysis. But the development of these centers are not simultaneous even in the same bone. The functions of these centers are like the primary centers, but the growing is radial. Since there is no perichondrium in the articular cartilages a structure like bone m. can not come up. The cartilage is trapped in two places when the bone tissue formed by the secondary ossification centers covers the epiphysis. One of these is the articular cartilage, which is permanent life long, with no share in ossificaion, the other is the Epiphysis plaque or the cartilage that

bonds epiphysis to diaphysis. As long as the cartilage of the epiphysis grows, this is replaced by the new bone formed in the diaphysis center. The elongation of the bone stops when growing of the epiphysis plate ends. Epiphysis cartilage is divided into five regions. Starting from the epiphysis site;

Rest area: Consists of hyalen cartilage which has no morphological changes in its cells.

Proliferation area: Here the cartilage cells, after growing rapidly, form isogenic groups in columns parallel to the long axis of the bone.

Hypertrophic cartilage area: Consists of large cartilage cells with glucogen accumulation in their cytoplasm.

Calcified cartilage region: With the death of cartilage cells, hydroxyapetite crystals precipitate on the thin septum of cartilage matrix and start calcification.

Ossification region: Enchondral bone tissue comes up. Osteoprogenitor cells which occur by the segmantation of the cells derived from periosteum, enter the spaces left behind by blood capillary cartilage cells. They form the osteoblasts which are distributed irregularly in the calcified cartilage matrix. In the last phase, osteoblasts accumulate the bone matrix on the calcified cartilage. With the calcification of the bone matrix, some osteoblasts become osteocytes. They consist of primary bone tissue, with calcified matrix in the center of the bone spicule and a layer of primary bone tissue around it. The elongation of long bones to epiphysis, happen by way of the proliferation of the condrocytes on the adjacent epiphysis plaque. At the same cartilage cells at the diaphysial site of the plaque become hypertrophic, matrixes calcify and the are eliminated. Osteoblasts furnish a layer of primary bone on the calcified cartilage spicules. The rates of these two opposite events are almost equal and the thickness of the epiphysis plaqued does not change . (1-3) Instead the diaphysis draws away from the bone center and causes the bone to grow longitudinally.

6. Calcification Mechanism

There is not yet a general hypothesis that can explain the precipitation of phospate on the bone matrix. It is known that calcification starts with the precipitaiton of calcium salts on the collogen fibres. Perhaps the precipitation of calcium salts in the inter cytoplasmic vesicules may be augmentated with the help of osteoblasts and secreted extracellularly when needed. Alkaline phosphatase produced by the osteoblasts that are on the calcification surfaces helps calcification in an unknown mechanism.

7.The Remodelling and Remodelling of the Bone

The growing of the bone occurs with a partial destruction of previously formed tissue to go together with formation of new tissue. (Bone formation is faster than bone destruction.) Therefore while the bone is growing its shape is preserved. In children, bone quickly goes under remodeling (bone cycle) and that could be as much as 200 fold compared to adults The remodeling of the bone depends on a few factors. These are, strain due to the muscle contractions and body movements, pregnancy, hormones and growth factor. Growth factors without known sources may show paracrine effect. This implies that they are produced locally. The growing of the cranial bones, in fact occurs by the periosteum that takes place between the outer surfaces and the and sutures. There is also resorbtion in the inner surfaces. Bone tissue that can change shape forms the skull following the growth of the brain. If the brain does not develop fully the skull remains small. In hydrocephalus known with the widening of the brain ventricules and with the accumulation of abnormal amounts of cerebro spinal fluid skull is greater than normal. The growing of long bones is a complicated procedure. Following the radial growth of the cartilage, epiphysis grow in dimension after enchondral ossification which increases the spongious part. Diaphysis (the bone formed between two epiphysis plaques) consists of a cylindiric bone. Due to fast growing of the epiphysis diaphysis extensions grow rapidly and two diaphysis funnels come out which are separated by diaphysis shaft. The size of the diaphysis shaft generally increases with the osteogenic activity of the epiphysis plaque, and the width increases with the periosteum at the outer surface modelling the bone. Meanwhile due to the increase in the space of the bone marrow, the bone is removed from the inner surface. Briefly; long bones grow longer with the activity in the epiphyseal plaques and widen with periostal aposition. When the growth of the epiphysial cartilage ends it is replaced by new bone tissue as a result of ossification process. The closure of the epiphysis follows a chronologic line for every bone and is completed around 20 years of age. It is possible to determine the age of someone young by studying the x-ray of the growing skeleton. This may show which epiphysis is open and which is closed. When the epiphysis is closed widening of the bones may continue whereas longitidunal growing becomes impossible.

8. Fracture Repairment

The bone matrix in the fracture site is destructed and the bone cells are eliminated. Local bleeding from the destructed blood vessels arises and blood

coagulates. During repairment, blood cloth, cells and destructed bone matrix are eliminated by macrophages. Osteoprogenitor cells in periosteum and endosteum in the fracture site rapidly proliferate and surround the fracture and form a tissue rich from cells between both sides of the fracture. Later; enchondral ossification of the small cartilage pieces that come out at the connective tissue of the fracture leads to primary bone formation. Bone formation may also occur with intramembraneous ossification. Thus; the formation of cartilage areas and intramembraneous and endochondral ossification at the fracture site happens more or less at the same time. The repairing phases develop as to connect the fracture tips of the irregular trabeculas of the primary bone and bone callus arises. During the repairment phase, and during the patient's returning to normal activity, the forces affecting on the bone help the callus remodel and the bone return to its status before the fracture. Primary bone tissue of the bone gets rezorbed in time and leaves its place to secondary bone and spesific structure of the bone is formed up again.

9. Histophysiology

9.1. Support and Prevention:

Bones form the skeleton that carry the body weight. Voluntary muscles go into the bone by tendons with connective tissue of periosteum Long bones forming systems of lift up augment the force achieved from muscle contractions. Bones protect central nervous system (skull bones and spine), the bone marrow and the organs in the thorax.

9.2. Remodelling Feature:

Despite their rigidity, bone can reshape its interior formation due to the different forces that act on them. For example; teeth can be regulated with orthodontic devices, and forces applied on the mandibula. Ossification is seen where the force pulls and rezorbtion where it pushes.(opposite direction.) Thus; with reshaping of the mandibula the position of the teeth can be changed. This ability is valid for all kinds of bones.

9.3. Calcium Stores:

Skeleton contains 99% of the body calcium, therefore Works as a calcium store. The amounts of calcium in blood and tissues is very strictly balanced. There is a continous calcium Exchange between the bone and blood. Calcium

rezorbed frome nutrients is rapidly stored in the bones. Excess amounts of calcium is excreted by feces and urine, and therefore high levels are prevented. Calcium in the bone is liberalized when the blood calcium decreases. The bone calcium leaves the bone with two mechanisms of one is rapid and the second is slow. The first one is the passing of ions from the hydroxyapetite cristals to interstitiel fluid and then to blood. This takes place in the spongious bone and is totally pyhsical and is augmented by the wide surface areas of hydroyxapetite crystals. Even in the adult bone, minimally calcified new lamels (as bone remodels continously) calcium is exchanged easily. In the preservation of blood calcium level the role of these lamels are more important than well calcifed old lamels that serve at protection and support as the primary function. The second way that liberalizes calcium depends on the hormones that effect the bone. Parathyroid hormone activates the cells that initiate the resorbtion of bone matrix, increases their number and as a result calcium is liberalized. Calsitonin produced from the parafollicular cells of the thyroid gland inhibits the matrix resorbtion. Calcitonin shows inhibitory effect on osteoclastic activity.(8-10)

Since tissue and blood calcium levels must be kept constant, bone decalfication will start due to nutritional disorders related to calcium. In that case, bones become fragile and allow x rays easily. Over secretion of parathyroid hormone also causes bone decalcification. In hyperparathyroidsm, the bone is resorbed and blood calcium levels increase. This time elevated blood calcium concentrations causes calcium abnormally to precipitate in some tissues like kidney and arter walls. (11,12)

9.4. Nutrition:

Especially in growing period bone is prone to nutritional factors. Insufficient protein intake, decreases the effectiveness of aminoacids and decreases the collagen synthesis in osteoblasts. Insufficient calcium causes incomplete calcification of the organic bone matrix. This may be a reason of insufficient calcium intake with foods or lack of vitamin D which is needed for resorbtion of calcium from small intestines. Vitamin D deficiency is not seen apparently (it is not absolutely depended on nutrition) It has been synthesised photochemically on the skin. It is hydroxylated in liver and kidneys, and turn into 1,25 dihydroxy cholecalciferol (1,25- dihydroxy-D3) Excess amounts of vitamin D is toxic and forms calcifications on soft tissue. (13,14) Another vitamin that shows direct effect on the bone is vitamin C which is needed for collogen synthesis carried

out by osteoblasts and osteocytes Vitamin C deficience effects bone growth, alternates the collagen synthesis and negatively effects the fracture repairment.

Calcium deficiency in children causes rickets Bone matrix cannot be calcified naturally and bone spicules formed by the epiphysis plaques bend with normal body weight and mucle activities. As a result, ossification is interrupted and not only the bones are deficient, but they also lose their shape. Calcium deficiency in adults forms osteomalasia which is characterized by immature calcification of the newly formed bone and partial decalcification of the calcified bone. But since there is no epiphysis cartilage in adults there is growing retardation and deformation of long bones typically seen in children. Osteomolosia that is not related to nutrition should not be mixed with osteoporosis. In osteomalasia the amount of calcium per bone matrix is law.(3-5) Whereas osteoporosis is seen in immobile women and in women after menopause. Here, either resorbtion increases or the bone mass decreases the to the reduction of bone formation. Sometimes both events can happen together. In osteoporosis matris mineral ratio is normal. Beside its effect on the resorbtion of calcium from small intestines, vitamin D as understood from in vitro experiments have direct effect on ossification. Bone tissue, planted on rich calcium culture without vitamin D, cannot be calcified as neccessary. (15-16)

References

1. Musculoskeletal system. In: Gray's Anatomy, 39th Ed. edited by Standring S, New York, Elsevier, 2004. 83-135.

2. Dere F. Anatomi Atlası ve Ders Kitabı . 5.baskı, Adana: Nobel Kitabevi, 11-17, 1999.;

3. Clarke B (2008) Normal Bone Anatomy and Physiology. *Clin J Am Soc Nephro;l* 3: 131–139, doi: 10.2215/CJN.04151206

4. Ozsahin E. The effect of Alendronate Sodium on Trabecular Bone Structure in the Osteoporotic Rat Model. PhD thesis. Cukurova University Faculty of Medicine, 2008.

5. Arıncı K, Elhan A: Anatomi ders kitabı, Güneş Kitapevi, 50, 2006.

6. Vaananen HK, Zhao H, Mulari M, Halleen JM(2000) The cell biology of osteoclast function. *J Cell Sci* 113 :377 –381.

7. Eriksen EF, Axelrod DW, Melsen F. Bone Histomorphometry, New York, Raven Press,1994 ,1– 12.

8. Carlos Jungueira L,Corneira J, Kelley RO. (1995) Basic Histology. A Lange medical Eighth edition. Appleton & Lange U.S.A, 132-151.

9. Kobayashi S, Takahashi HE, Ito A,et all(2003) Trabecular minimodeling in human iliac bone. *Bone* 32: 163–169.

10. Taichman RS. (2005) Blood and bone: Two tissues whose fates are intertwined to create the hematopoietic stem cell niche. *Blood* 105: 2631–2639.

11. Teitelbaum SL, Abu-Amer Y, Ross FP(1995) Molecular mechanisms of bone resorption. *J Cell Biochem* 59: 1–10.

12. Landis WJ.(1995) The strength of a calcified tissue depends in part on the molecular structure and organization of its constituent mineral crystals in their organic matrix. *Bone*; 16: 533–544.

13. Cohen MM. (2006) The new bone biology: Pathologic, molecular, clinical correlates. *Am J Med Genet A* 140: 2646 –2706.

14. Roodman GD. (1999) Cell biology of the osteoclast. *Exp Hematol;* 27:1229 –1241.

15. Boyle WJ, Simonet WS, Lacey DL. (2003) Osteoclast differentiation and activation. Nature 423: 337–342.

16. Blair HC, Athanasou NA. (1999) Recent advances in osteoclast biology and pathological bone resorption. *Histol Histopathol* 19: 189 –199.

17. Melton LJ. (2000) A conflict between clinical and public health perspectives. *J Bone Miner Res* 15:2309-2314.

CHAPTER IX

ASSESSMENT AND FOLLOW-UP OF ELDERLY; NURSING APPROACH

Çiğdem ÖZDEMİR ELER[1] & Gülay TURGAY[2]

[1]Başkent University, Vocational School of Health Services, Ankara, Turkey,
e-mail: cigdemo@baskent.edu.tr,
ORCID: 0000-0002-5900-4220

[2](Asst. Prof. Dr.) Başkent University, Vocational School of Health Services, Ankara, Turkey,
e-mail: gturgay@baskent.edu.tr,
ORCID: 0000-0003-2790-1426

1. Introduction

Today, with the prolongation of life expectancy, There is an increase in the number of people with physical limitations in the elderly population. Chronic diseases that occur with aging cause physical, mental and social deficiencies in the elderly.

In the comprehensive assessment of the elderly, the focal point is the functional status of the individual. Physical, psychosocial and socioeconomic factors affecting their functional status are in interaction with each other. Each factor should be examined separately in order to comprehensively evaluate the health status of the elderly. For this purpose, different branches should work as a multidisciplinary team.

It has become a necessity in modern geriatrics to deal with the problems that arise with aging as a whole and to evaluate the elderly person in a multifaceted manner. This interdisciplinary process aims to determine the medical, psychosocial and functional powers and deficiencies of the elderly and to create a general plan that includes long-term follow-up and treatment.

Considering the demographic change in the world, the importance of nursing care, which understands the care needs of the elderly, plans the care and rehabilitation of the elderly, ensures the continuity of the current level of function for the protection and development of health and evaluates the individual as a physical, psychological, social and cultural whole is gradually increasing.

2. Evaluation of Elderly

Comprehensive geriatric assessment (multidimensional geriatric assessment); It is an interdisciplinary assessment in which the multiple problems of the elderly are uncovered, defined and explained. Their capacities and long-term needs are identified, necessary services are identified, a coordinated treatment plan is developed, and comprehensive medical, functional, psychosocial and environmental assessments are made. The purpose of the elderly assessment; It is to enable nurses to collect data on the elderly, to identify the problems of the individual, to make appropriate nursing diagnoses, and to make necessary interventions (1).

A different perspective is required when evaluating the geriatric patient. Because important physiological changes occur in organs and systems in the elderly. In geriatric patients, decrease and loss of functional capacity, decrease in daily living activities and limitations develop. Diseases are frequent and atypical. Disease factors, symptoms and findings are different in geriatric patients. Multiple pathology and polypharmacy are common. Diseases and complaints of the elderly are often ignored and considered as a natural consequence of aging. The approach of the elderly patient is generally similar. For these reasons, the rate of reporting symptoms to the doctor is low. All of these cause delayed diagnosis and treatment (2,3).

Important factors in the evaluation of elderly

✓ The physical, psychosocial and socioeconomic factors that affect the health and functional status of the elderly are interrelated.

✓ In order to comprehensively assess the health status of elderly individuals, each factor needs to be examined separately. Therefore, it requires a multidisciplinary approach.

✓ In the comprehensive assessment of older individuals, the focus should be on the functional status of individuals. While investigating treatable problems

and underlying etiological factors, traditional health status evaluation criteria such as diagnosis, physical and laboratory findings are useful, but the need for health and social services is more important in older individuals than healthy and well (4).

Differences between multidimensional geriatric evaluation and classical medical evaluation

✓ Targets patients with complex health problems, which we refer to as frail elderly patients

✓ Prioritizes functional status and quality of life.

✓ It frequently uses interdisciplinary teamwork and quantitative evaluation scales (4,5).

Elderly individuals are evaluated by different methods. Comprehensive studies have been conducted and different strategies have been developed for the evaluation of the elderly. Although the evaluation of the elderly individual differs according to the age and specific problems of the patient, it also differs according to the status of the elderly individual being in the hospital, home or nursing home (1,5).

Benefits of comprehensive geriatric evaluation are; decrease in dependence on activities of daily living, prolongation of life, preservation and improvement of functional status, decrease in hospitalizations, decrease in mortality, decrease in the need for nursing homes, decrease in costs, increase in quality of life (3,6).

Goals of multi-dimensional geriatric assessment

✓ Inhibiting iatrogenesis

✓ To reveal the functional status and problems caused by its disorders

✓ Identify potential risk factors to prevent functional loss

✓ Helping to track clinical change over time

✓ Identifying practices that will preserve or regain functional ability

✓ Strengthen the possibility of correct diagnosis for social and medical plan

✓ Determining the optimal treatment/care environment for the elderly

Medical conditions that underlie and contribute to functional loss should be identified and treated appropriately. The on-site use of comprehensive geriatric assessment will result both in meeting the needs of individuals appropriately and under-utilizing nursing homes and similar settings. A systematic approach can be applied to the assessment of the elderly. The nurse who will serve the elderly should approach the elderly individual as a whole with a physical, psychological and socio-economic perspective. (7).

Methods for effective evaluation

✓ Developing the health team to reduce unnecessary evaluations in elderly individuals

✓ Obtaining information about patients from health record forms and family members in advance

✓ Application of screening tests for a more detailed evaluation of elderly individuals

✓ Using evaluation forms prepared in computer environment

✓ Discussion of evaluation results, physical examination and treatment options

Deterioration of quality of life in elderly individuals is manifested by limitations in daily living activities and functional inadequacies associated with it. Evaluation of functional status and disability is an indispensable part of physical examination. Therefore, in addition to medical evaluation, simple, time-consuming and reliable functional evaluation scales and quality of life and independence level in the elderly should be revealed (8.9).

Comprehensive geriatric evaluation includes functional, mental and social evaluations beyond medical diagnostic evaluation. Other components of the assessment; These are advanced directives that discuss the patient's economic situation, the characteristics of his environment, and the patient's choices. Comprehensive assessment of patients on cognitive impairment, depression, conduct disorder, mobility, incontinence, nutrition, sleep, vision, hearing, caregiver and social support, driving, home security, and finances allows more problems to be identified and treated. (10,11).

Although all elderly individuals benefit from geriatric evaluation, sometimes simple investigations into common problems may suffice. Of the broader assessments, the elderly who are "fragile" or at high risk of institutionalization and who are in decline in functional status benefit most. The term "fragile"

often includes unexplained weight loss, weakness, slowed walking speed, and decreased physical activity, leading to increased comorbidity and functional dependence (12).

The most appropriate implementation of geriatric assessment is possible with an interdisciplinary team. In the interdisciplinary team; clinicians, nurses, social workers, dietitians, physiotherapists, psychologists, occupational therapists, dentists, pharmacologists, speech therapists, audiologists should be present. Some simple screening tools have been defined to facilitate the diagnosis of common geriatric problems. These tools are intended to monitor pathological responses with further testing or research after some sensitive pre-screening questions or tests. (13).

Detailed Geriatric Evaluation is used to reveal the general health status of elderly people. Detailed geriatric evaluation was originally prepared in a way to cover, reveal and explain many problems of elderly people, and it was planned to coordinate in accordance with the problems of the person, determine the service need, and reveal the situation of the strengths and resources of the individuals. Since the 1990s, geriatricians and oncologists have tried to integrate this assessment into clinical practice (12,13).

Evaluating quality of life with scales helps clinicians to objectively show what they have done about treatment and to set goals in order to make further treatment plans. Although there is no consensus that the definition of quality of life should include many dimensions of life, it is still a controversial issue which dimensions should be. For this reason, a standard has not been determined for the scales put forward. However, there is no widely accepted scale in the older age group. In the scales to be used; The characteristics of being able to change over time, multidimensionality, being affected by the interaction with the individual and the environment, adapting to the expectations and events of the person are sought. On a good scale; The questions should be short, easy to understand and correctly structured, and there should be no ambiguity in the answers. It should be noted that elderly people may be sensitive to some questions (11).

Quality of life measures can be implemented in different ways as general and disease-specific, size-specific and individualized measures. The most important advantage of the general scales, which are applied in a wide area, is that they can be applied to individuals with different health problems and that comparative data can be obtained according to the general population. Its disadvantage is that it is not sufficiently sensitive in patients with special health problems or in specific studies (12).

3. Frequently Used Scales

Medical Outcome Study-Short-Form (SF 36): It has 8 subtitles, and these subtitles can be grouped as physical and mental health and social status. Its validity and reliability were evaluated on different harvest groups in different countries. It is a general quality of life assessment scale and is not designed for the elderly. It is considered to be suitable for healthy groups rather than the frail elderly living in institutions. It is recommended to be filled with an observer in the advanced age group. There are also short forms (SF 12, SF 8) (14).

Notthingham Health Profile (NHP): It is one of the scales that evaluates the quality of life in general. It has 6 dimensions assessing pain, energy, emotional response, sleep, social isolation, and physical condition. It consists of 38 questions. There is no evidence of a special study for the elderly or that it can be used in this age group (15).

Sickness Impact Profile (SIP): It consists of 12 dimensions and 36 questions such as walking, self-care, emotionality, communication, social status, leisure time, eating, working, and housekeeping. Taking a long time is a disadvantage. It is stated that it is frequently preferred because its content is suitable for the elderly and the questions are clear (16).

Quality of Well-Being (QWB): It is a scale based on the symptoms and functions of any disease. Evaluates mobility, physical and social activities. It consists of 31 questions (12).

Geriatric Quality of Life Questionnaire: It is a scale prepared for the advanced age group living in the society. Although it was prepared for the frail elderly group, it is not more valid and explanatory than other scales in evaluating activities of daily living and emotional status (12).

LEIPAD [LEIden (Netherlands), PADua (Italy) and Helsinki (Finland)] QOL: Physical and mental status, social characteristics, cognitive function, financial status, mood, environment and sex dimensions are evaluated. It consists of 49 questions. In older people; It has been used in cancer, hepatic diseases and substance abuse. It has been tried in different countries (12).

World Health Organization Quality of Life (WHOQL)-BREF: It is applied for people of advanced age. It consists of 26 questions. It has subheadings that evaluate physical, mental, health, social and environmental. It is stated that it can be used for screening purposes (10).

Patient Generated Index: It is a moderately reliable scale that is easy to perform but has a poor response to changes, and its use in clinical practice and research is limited (12).

In 1998, the World Health Organization (WHO) revealed that it supports the WHOQLBREF and LEIPAD scales in assessing quality of life. SF 36, on the other hand, is an older and general scale (16).

Different scales have also been developed to be used in disease or condition-specific assessments. As an example of these; Incontinence QOL Instrument, Parkinson's Disease 39 Item Questionnarie, Quality of Life Questionnarie of the European Foundation for Osteoporosis, quality of life form for cardiac patients, 3-point assessment scale for dementia can be given. Although these scales are specific and sensitive, their disadvantages are that they are not widely used and that comparative data cannot be obtained (17).

"Instrumental Daily Activity Scale", which was developed by Lawton and Brody in 1960 and continues to be used today, "Independent Index in Activities of Daily Living" developed by Katz and Maslow's "Basic Human Needs Pyramid" can be used in determining needs. In addition, mini mental test, geriatric depression scale, mobility index, Pittsburg sleep quality index, fall risk, nutrition, sexuality, urinary incontinence, hearing, vaccination, pain evaluation, forms related to neglect and abuse of the elderly are used (12).

4. Assessment Areas

Comprehensive geriatric evaluation should begin with a careful general medical examination. Patients should be asked about their previous diagnoses, physical disabilities if any, multiple drug use, annual hospital stay, how long they have been unable to do their activities due to the disease, and how often they consult a physician. Systemic physical examination findings should be recorded. When performing geriatric evaluation, specific conditions commonly seen in elderly patients should be systematically investigated. Physical, mental and psychosocial problems should be known in detail in order for rehabilitation for the elderly to reach its goal. Therefore, besides medical evaluation, nurses; It is very important to evaluate the physical, functional and social level of the elderly person. (17,18).

History and physical examination

Each patient should be evaluated individually, but in general, there are some points to be considered when taking a history from a geriatric patient. In addition, one of the things that should not be forgotten is that laboratory values may differ from normal values due to the physiological changes brought about by aging in this age group.

A well-lit, relaxing environment should be provided when meeting with the patient. Appointment times should be planned according to the patient's request. The story should be taken slowly and calmly, carefully and with sufficient time. However, conditions such as decreased vision and hearing, depression, and deterioration in cognitive functions may cause difficulties in taking the history. To reduce the time required for the initial evaluation; A well-organized pre-visit form can be used that includes information about medical history, medications, and functional status. If the patient cannot complete the form, a family member or caregiver can help. When the patient is tired or bored, history taking can be completed after a pause.

Starting the history with questions that will reveal the mental state of the patient may be important for the reliability of the answers. Regardless of mental status, elderly patients are usually accompanied by family members. Although some elderly patients are more comfortable in the presence of family members, this decision should be left to the patient.

There is an effective relationship between social relations and functional status and mortality in the elderly. For this reason, it should be questioned with whom the patient lives. Most seniors use a variety of medications. All drugs used should be reviewed.

Examination in geriatric patients starts from the first time the patient is seen and the patient's posture, speech style and facial expressions give the first clues to the physician. General view of the patient; It contains a lot of information such as hygiene, urine smell, signs of abuse. The motor movement ability decreases over time and the presence of fear of falling caused by previous experiences in some of the patients reduces the movement speed of these patients. For this reason, while the patient is taken to the examination table and given the appropriate examination position, sufficient time should be allowed and the patient's confidence should be maintained.

Detailed systemic examination, especially neurological, cardiovascular, and mental status examinations, should be performed on patients. Examination findings such as skin pallor, murmur on the carotid arteries, presence of plugs, oral and dental examination, barrel chest, kyphoscoliosis, and prostatic hypertrophy become more important in the elderly (6,7,10,19).

First admission algorithm for patients aged 65 and over

- General condition, posture, speech, facial expressions
- History taken from him

- Anamnesis taken from relatives
- Retrieval of vital signs
- Evaluation of the state of consciousness
- Skin examination
- Mouth-throat-tongue examination
- Eye examination
- Ear-nose examination
- Head and neck examination
- Examination of the lungs
- Cardiovascular system examination
- Abdominal examination
- Locomotor system examination
- Neurological examination (11).

This process; It includes collecting comprehensive data on the characteristics of the elderly individual. In this process, the nurse evaluates many factors together in determining their needs. Information about the medical history of the elderly person and the diagnosis and treatment of the disease should be obtained. The nurse should review the records obtained by observation, interview, physical examination and related laboratory and diagnostic tests and other methods. In this context, the nurse observes the behavior of the elderly individual, asks questions, evaluates clues and performs physical examination (swallowing ability, gastrointestinal motility, muscle mass, vital signs, etc.). In the evaluation, the nurse should deal with auditory, visual and perceptual disorders at the first stage, question whether she uses assistive equipment or not, and if so, examine the suitability of the equipment.

At the beginning, the nurse evaluates the age, body weight, Body Mass Index (BMI), vital signs, health and disease history, diet, drug allergy and intolerance, and ability to perform activities of daily living (movement, nutrition, personal hygiene, dressing, excretion, etc.). should be identified. In addition, the nurse should inquire about drug allergy and intolerance, prescription and over-the-counter drugs used before and currently, polypharmacy status, use of non-therapeutic (eg alcohol, caffeine, nicotine, cocaine, cannabis, etc.) drugs (12).

Components of a comprehensive geriatric assessment

Affecting functional status; There are various tools used to evaluate components such as basic activities of daily living, vision, hearing, falls, cognitive impairment, instrumental activities of daily life, mobility, depression,

malnutrition, oral and dental health, urinary incontinence, and environmental factors.

The nurse should pay attention to some system-related symptoms while evaluating the elderly. These indications in systems are important as they facilitate early diagnosis of major problems.

Cognitive functions

In the cognitive assessment of the elderly patient, dementia and delirium are usually emphasized. Although these conditions can be separated from each other in terms of development time, pathophysiology and clinical appearance, they can be found in the patient at the same time. It should not be forgotten that the presence of dementia in elderly and hospitalized patients may be a risk factor for the formation of delirium. Cognitive function in the elderly; It is observed in a spectrum ranging from changes seen with normal aging to dementia. The most serious type of cognitive impairment is dementia. Initial findings may be quite faint. In older people, dementia and cognitive impairment should be identified as early as possible. Drug therapy for Alzheimer's can improve the patient's quality of life, prolong the period of relatively better functioning, delay the need for nursing home placement, and ultimately reduce the cost of health care. In addition, early diagnosis offers patients and their caregivers the ability to plan for their future needs. The most important part in the evaluation of a patient with possible dementia is the patient's history. It is possible to evaluate the near and distant memory while the patient is telling his/her story. Since the history taken from the patient may be incomplete and inaccurate, a history should also be taken from relatives or caregivers. The progressive course of forgetfulness, language problems, personality changes or psychiatric symptoms should be evaluated (19,20).

Mini Mental Test

It is a commonly used test for cognitive status assessment. The test consists of 11 questions and is evaluated over 30 points. A score of 24-30 is normal, a score of 18-23 is compatible with mild dementia, and a score of 17 or less is compatible with severe dementia. It tests orientation, memory, attention, calculation, recall, language, motor function and perception, visuospatial abilities, and being easy and applicable is its biggest advantage. It is necessary to know the cases where it is false negative and false positive. False-positive

results in mild cognitive impairment, advanced cognitive impairment, frontal lobe dementia, those with low education level and poor language skills; False-negative results can be obtained in individuals with a high education level (21).

Clock Drawing Test and 3-Item Recall

It is quick and easy to use the "three-item recall method" together with the "clock drawing test". Dementia is excluded if the patient can draw a full clock and remembers the three items said. These tests can be especially helpful in untrained people and patients with language problems.

The patient is asked to draw a clock in a certain time period. There are several clock drawing tests, each with a different scoring system. Normal watches contain all the numbers in the correct position and accurately display the desired time. It is considered one of the tests that fail in the early stages of dementia. Constructional praxis tests understanding and planning ability. It is evaluated out of a total of 6 points. Below 4 points is compatible with impaired cognitive function.

Scoring:

- 3 points: 12 correct places
- 1 point: written in 12 numbers
- 1 point: Hour and minute hands drawn
- 1 point: The time spoken is correctly marked (22).

Delirium

Delirium is acute, fluctuating changes in awareness and attention. It is especially common in hospitalized elderly patients. It is often overlooked because its symptoms can be variable. Various methods can facilitate the diagnosis of delirium. The "confusion assessment method" is the most frequently used method. The clinician uses this test to diagnose delirium; It makes the diagnosis by showing an acute onset and fluctuating mental state change, impaired attention and disorganized thinking or a change in consciousness. In addition to the first two criteria, one of the third criteria must be present for diagnosis. The sensitivity of this method is 94-100% and the specificity is 90-95%. Since the hallmark of delirium is variability, the patient may be fully conscious during the

evaluation. For this reason, it is important to get information from caregivers. (23).

Mood Assessment

Depression is a common psychiatric problem that significantly affects morbidity and mortality in the elderly. Depression in the elderly is not an inevitable consequence of getting older. This is a disease state. The prevalence of depression in the sick and hospitalized elderly was about 25%. "Do you ever feel sad or sad?" It is recommended to scan a simple question such as When the answer is positive, the "Geriatric Depression Scale (GDS)" should be applied. "Yesavage Geriatric Depression Scale" has been developed for elderly patients. The validity and reliability of the 15-question short form, which was developed for ease of use, has been proven. "Hamilton Depression Scale" can be used for further clinical evaluation for depressive symptoms (23,24).

Evaluation of Vision

The most important causes of vision loss in advanced age are; cataracts, glaucoma, macular degeneration and diabetic retinopathy. In general, the elderly patient should undergo a visual evaluation at least once a year. Although the Jaeger Card, which is one of the accepted screening methods, can be used for near vision and the Snellen Vision Card for distance vision, periodic examination by an ophthalmologist is recommended, especially in the elderly with diabetes and at high risk for glaucoma (22,25).

Evaluation of Hearing

Hearing loss occurs in 50% of individuals over the age of 85, and approximately 33% of individuals over the age of 65. Hearing impairment; causes social isolation, depression, and functional decline. Treatment with hearing aids has been shown to improve quality of life. Whisper test is applied as a performance test. Move 20-40 cm behind the patient, close one ear, say 3 words and ask the patient to repeat these words. It is an easy-to-apply test with a sensitivity and specificity of 70-100%. Another test that can be applied is the "Hearing Handicap Inventory for the Elderly -Screening" developed for screening for hearing impairment in the elderly. Patients are asked 10 questions and the answers are scored. This test is important in demonstrating how hearing loss affects functional status (26).

Oral and Dental Health

The management of dental health, such as vision and hearing problems, requires advanced specialist evaluation. The "Dental" method is used for scanning. It contains 6 items; dry mouth, mouth lesions, difficulty eating, mouth pain, change in food choice, and lack of recent dental care. The presence of one of the first three items or two of the last three items requires referral to a dentist (22).

Nutrition Evaluation

Weight loss or malnutrition; It may be a symptom of functional impairment, dementia, or medical illness. There is no single definition of malnutrition in the elderly. Involuntary weight loss of 10% or more in the last 6 months is associated with increased morbidity and mortality and requires further evaluation in terms of malnutrition. Anthropometric measurements are used to evaluate malnutrition. A body mass index (BMI) below 22 in the elderly may indicate malnutrition.

Mini Nutritional Assessment (MNA: Mini Nutritional Assessment); anthropometric measurements, general assessment, dietary factors, and the patient's own statements were created. It is evaluated out of 30 points. Below 17 points indicates malnutrition. If the first part is risky (may be ≤ 11 Malnutrition), the second part is passed (25,27).

Continence Assessment

Urinary incontinence is not a natural result of aging. Genitourinary pathology is the loss of urinary control due to age-related changes, comorbid conditions, and a combination of drugs and environmental barriers. Urinary incontinence is common in the elderly, but often overlooked. It is almost twice as common in women as in older men; Urinary incontinence in elderly women can occur daily at a rate of approximately 6-14%. For screening, it is recommended to simply ask whether there is a urine leakage problem and whether this problem has occurred at least 5 different times. Those with urinary incontinence should be examined further.

Fecal incontinence; It is the involuntary or inappropriate passage of faeces that affects social functions or hygiene. It is seen in 2% of the population over the age of 65, 14% in hospitalized people, and 54% in nursing homes. Constipation, being over 80 years old, female gender, urinary incontinence, mobility problems, dementia, neurological diseases are risk factors. The causes are often multifactorial. It should be considered in elderly patients (28).

Polypharmacy

Considering the biophysiological, psychological, social and cultural dimensions of the elderly individual, nurses have important roles and responsibilities in drug management. Polypharmacy is the use of multiple drugs, often for more than one indication at the same time. The risk of polypharmacy increases with age. The elderly are users of prescription and over-the-counter drugs due to multiple diseases. It is an important reason for hospitalizations. Adverse drug reactions can be fatal and are common. Careful review of the drug list is necessary to avoid undesirable drug interactions, avoid adverse drug reactions, and reduce cost. Geriatric evaluation can reduce polypharmacy, the frequency of adverse drug effects, and inappropriate drug prescribing (29).

Pain

Pain management is inadequate worldwide, pain in older cancer patients receives less attention. Comprehensive evaluation is performed for the cause of the pain, the characteristics of the pain, and its effects on physical and psychosocial functions. The patient's self-report is the primary source in the assessment of pain. Standard pain scales such as "0-10 Scale" and "Visual Analog Scale (VAS)" can also be used (15).

Pressure Sores

Age-related changes such as dryness of the skin, loss of subcutaneous adipose tissue and decreased immune response, as well as decreased mobility and malnutrition; It can aggravate skin problems in the elderly with comorbid diseases and delay their resolution. Although it is considered as an indicator of quality of care and the aim of palliative care is to provide a comfortable end of life, pressure ulcers are common in elderly patients. A complete examination of the skin is necessary, showing the development of the ulcer, its degree, localization. "Norton Scale" and "Braden Scale" may be useful as protective measures (19).

Functional Status

Physical function assessment is recognized as the center of comprehensive geriatric assessment. Functional status is defined as "a person's ability to perform their duties and meet the complex social roles required by activities of daily living". Functional disability is common in elderly patients due to

many potential causes such as age-related changes, social factors, and diseases. Functional status assessment is done at 3 levels. Basic Activities of Daily Living, Instrumental Activities of Daily Living, and Advanced Activities of Daily Living.

Basic Activities of Daily Living; defines functions that are necessary, but not entirely sufficient, to ensure independent living. Basic functions; feeding, continence, transfer, using the toilet, dressing and washing. Individuals with multiple dysfunctions at this level will need serious home support or hospice placement, such as 24-hour care.

Instrumental Activities of Daily Living; It includes more complex activities necessary to maintain home life. These; These are activities such as paying bills, taking medications, shopping, preparing meals, protecting the home, transport, using the telephone. If there are several deficiencies in these areas, an assisted lifestyle is often required, perhaps some household assistance. At this level, opportunities and motivation contribute significantly to the continuity of the function.

Advanced Activities of Daily Living; represents the highest level of activity. These; It includes activities such as working, volunteering, maintaining hobbies. These areas of interest are; it is highly sensitive to changes in health status, as it complexly requires the highest levels of multiple abilities (26,29).

Evaluation of Mobility and Falls

Older people often have walking and balance difficulties. As a result, about 30% of those over the age of 70 fall once a year or more. This results in an increased incidence of hip and other injuries that increase the risk of developing other medical complications such as dehydration, pneumonia, urinary retention, and infection that bind patients to bed.

Generally, the etiology of falls depends on many factors and includes visual impairment, neurological or vestibular disease, postural hypotension, decreased muscle mass, joint disease, and various foot disorders. Falls, which usually occur at night, are more common in dementia and their frequency increases with drug use. It has been shown that rehabilitation and strength training can improve muscle mass, balance and gait and reduce the risk of falls.

Gait and balance tests should be applied to the elderly who have been found to have fallen within the last 1 year. If there is a problem in these tests, multi-dimensional fall assessment is performed. While performing the “Get Up and Go Test”; the patient gets up from the seat without using his arms, walks 3

meters, turns, sits again. “Timed Up and Go Test” is applied by keeping time. Applications lasting 15 seconds or longer were found to be compatible with impairments and falls in activities of daily living. The Tinetti Performance and Mobility Assessment is used in balance and gait assessment (29,31).

Social Support and Environment

There is a strong link between the patient’s social functions and health status. Elderly relationships in times of physical or emotional stress; may show the difference between staying independent in the community and needing a nursing home. A gold standard for measuring social function has not been defined. Social functions with comprehensive geriatric evaluation; It has been proposed to combine six aspects such as social networking (social relationships and connections), social support, subjective well-being and happiness, caregiver burden, values and preferences, and social resources (income, household status, assets).

The healthcare team member who knows the elderly and their family best and can observe them in the process is the nurse. The nurse evaluates not only the inadequacies and needs of the elderly individual, but also his resources and self-management strategy. The health worker who is part of the social story should ask the following questions: “Who lives next to the patient? Who is cooking? If it cannot provide transportation, who provides it? Is the patient caring for anyone?”. To quickly assess the patient’s social support; Ask if they have anyone they can call when they need help, or if they have friends or relatives they can contact. Home safety assessments, which cause falls; it should be aimed at revealing the most common threats, such as poor lighting, unclear transitions and loose rugs (27,30,31).

In conclusion;

Geriatrics; It is a field of study that requires special attention, skill, experience, willingness, tolerance and patience in this regard, due to the characteristics of the age group it cares for. Nurses; They use the nursing process by planning the care of elderly individuals scientifically and systematically and individually. In the nursing process; Evaluation of the elderly and determining their needs have an important place. For this reason, it is very important for nurses to have up-to-date and practical information about the subject, to determine the needs of the elderly individual and to choose the most appropriate model. The importance of elderly assessment is increasing in terms of improving the health of the elderly, eliminating risk factors, preventing disease and disability, early diagnosis and improvement of diseases, and social support of the elderly.

References

1. Avaş S, Akçiçek F. Comprehensive geriatric assessment. Aegean Medical Journal. 2010; 49(3):19-30.

2. Şahin S, Taşar PT, Baybaş BK. Interdisciplinary and multidisciplinary team concepts in comprehensive geriatric assessment. Turkiye Klinikleri Geriatrics Special Topics. 2018; 4(3):8-11.

3. Esme M, Yavuz BB. Components, purpose and benefits of comprehensive geriatric assessment. Turkiye Klinikleri Geriatrics Special Topics. 2018; 4(3):1-7.

4. Kanadlı KA, Sazak Y, Tosun N. Multidisciplinary team approach and the role of the nurse in multifaceted geriatric assessment. Journal of Geriatric Science. 2021; 4(1):15-22.

5. Şahin S. Geriatrics and health in old age. Gerontology Vol. 1 1st Edition. Ankara:Nobel; 2017; 181-94

6. Yavuzer H, Cengiz M. Multidimensional geriatric assessment. Turkiye Klinikleri Journal of Internal Medicine. 2016; 1(1): 17-23.

7. Bektaş H, Kalav S. Comprehensive geriatric assessment. Internatıonal Refereed Journal of Nursıng Researches. 2017; 201-231.

8. Aslan D, Keskin C. The public health aspect of the concept of the "fragile" elderly. Journal of Contınuıng Medıcal Educatıon. 2015; 24 (2): 73-79.

9. Altunok H, Atalay BI, Önsüz MF, Işıklı B. Recommended screening tests in old age. Preventive Medicine Bulletin. 2016; 15(6): 588-595.

10. Yavuz BB. Geriatric evaluation and tests. Journal of Internal Medicine.2007;14: 5-17.

11. Özdemir L, Akdemir N, Akyar İ. Elderly evaluation form developed for nurses and geriatric problems. Turkish Journal of Geriatric. 2005; 8(2): 94-100.

12. Tavşanlı NG. Fundamentals of Nursing. Elderly care nursing. Nobel Academic Publishing Education Consultancy. Ankara; 2015: 79-90.

13. Wieland D. Ferrucci L. Multidimensional Geriatric Assessment: Back to the Future. J Gerontol Med Sci.2008; 63:272-274.

14. Kutsal YG. Basic geriatrics. Güneş Medical Bookstores, Ankara; 2007; 117-123.

15. Arıoğul S. Geriatrics and Gerontology. MN Medikal&Nobel. Ankara; 2006; 137-147.

16. Karadakovan A. Elderly health and care. Academician Medical Bookstore. Ankara; 2014; 279-344.

17. Erdoğan T, İlhan B, Çinçin AF, Bahat G, Karan MA. Comprehensive geriatric assessment in practice: what do patients say? J Ist Faculty Med. 2022; 236-241.

18. Akın G. Aging in every way. Palme Publishing. Ankara; 2006; 155-210.

19. Tiftik S, Kayış A, İnanır İ. Systemic changes, diseases and the role of the nurse in elderly ındividuals. Turkish Journal of Geriatrics, 15 (special issue). 2012; 96-99.

20. Aydoğan Ü, Onar T, Nerkiz P. Physiological changes in aging. Gerofam.2011; 2(3):1-12.

21. Christos I, Alexandros M, Aikaterini F, Kiriaki T, Lambrini K. Diseases of the musculoskeletal system in the elderly. Journal of Pharmacy and Pharmacology.2015; 3: 58-62.

22. Fleg JL, Strait J. Age-associated changes in cardiovascular structure and function: a fertile milieu for future disease. Heart Failure Reviews,2012; 17(4-5): 545-554.

23. Gil JA. Mello ALF, Barrios R, Gonzalez MA, Bravo M. Oral health in the elderly patient and its impact on general wellbeing: a nonsystematic review. Clinical Interventions in Aging.2015; 10: 461-465.

24. Keskin A, Uncu G, Tanburoğlu A, Adapınar D. Aging and senility related neurologic diseases. Osmangazi Medical Journal. 2016; 38(1): 75-82.

25. Karan MA. Physiological changes in endocrine and immune systems in geriatric age group. https://tihud.org.tr/uploads/content/kongre/ 5/5.32.Pdf. Access Date:05.12.2022

26. Mercanlıgil M. Nutritional therapy in elderly people with diabetes. Journal of Nutrition and Diet. 2019; 47,60- 66.

27. Yerli G. Old age characteristics and social services for the elderly. International Journal of Social Studies.2017; 10(52): 1278-1287.

28. Aydıner BA, Günay G. The effect of perceived social support on life satisfaction in elderly individuals. Journal of Human and Social Sciences Research. 2018; 7(2): 1351-1363.

29. Ali A. Physiological changes in the elderly, Ordu University Journal of Nursing Studies. 2020; 3(3): 347-354.

30. Kutsal YG. Geriatric Rehabilitation. Turkish Journal of Physical Medicine and Rehabilitation. 2010; 252-277.

31. Cankurtaran M, Halil M. Approach to the Geriatric Patient. Türkiye Clinics J Med Sci.2008; 28: 262-266.