Journal of Health Study and Medicine

2022, No. 2

Redaktor naczelny / Editor in chief
Prof. dr hab. Jan Krakowiak

Skład / Adjustment, Typesetting
Studio Grafpa, www.grafpa.pl

ISSN 2451-1471

ul. Sienkiewicza 9
90-113 Łódź
tel. (42) 664 66 41
e-mail: wydawnictwo@spoleczna.pl

Wersja elektroniczna publikacji jest podstawową, dostępną na stronie:
jhsm.san.edu.pl
E-version is the orginal version of the article, available:
jhsm.san.edu.pl

Artykuły recenzowane / All the articles published are subject to reviews.

Spis treści

Journal of Health Study and Medicine
2022, No. 2
pp. 5–28
DOI 10.36145/JHSM2022.08

Quality Management in Dental Offices in the Lodz Voivodeship in the Opinion of the Facilities' Employees and Owners

Submitted: 13 October Accepted: 20 November 2022 Published: 30 December 2022

Agata Zuzanna Kunert[1]
https://orcid.org/0000-0002-5392-9548

Dominika Cichońska-Rzeźnicka[2]
https://orcid.org/0000-0001-8623-4307

Jan Krakowiak[1]
https://orcid.org/0000-0002-3435-9658

[1] Department of Social Medicine and Preventive Medicine, Medical University of Lodz, Poland
[2] Department of Health Sciences, Medical University of Lodz, Poland

Address for correspondence

Agata Kunert
Department of Social Medicine
Medical University of Lodz
4 Tadeusza Kościuszki St.
90-419 Lodz, Poland
agata.kunert@stud.umed.lodz.pl

Abstract

Background: *The benefits of introducing specific procedures in a company have been proven. They systematize the work, increases the efficiency of the enterprise and employee productivity. They also allow the owners to reduce waste and maximize the company's profits. The standard for improving quality in the enterprise presented by the International Organization for Standardization is the 9000: 2015 norm, it is the applicable standard. Possible barriers to the implementation of the procedures and quality improvement, such as ISO standards or accreditation for dental clinics, were assessed. The main barriers include the standards' inadequacy to the size and structure of the facility, and thus the costs of its implementation are disproportionate to the benefits for dental clinics.*

Objective: *The aim of the study is to assess the demand for a holistic and cross-sectional quality management system in dental clinics in Poland and to create procedures adequate to the needs.*

Material and methods: *The research was carried out among the owners/managers of dental clinics in the Lodz Voivodeship and their employees: doctors, dental assistants/hygienists, medical recorders/patient caregivers. The tool applied was an anonymous questionnaire in an electronic form, intended for self-completion by respondents. The study began in June 2022 and continued until 215 questionnaires were collected from dental office employees and 39 questionnaires from owners and managers. The data was compiled using the Statistica software.*

Results: *The presented results clearly show the need for procedures and their standardization as well as quality improvements in dental offices. More than 66.5% of employees and 68.4% of dental offices' owners point out a positive impact and the need to introduce procedures and improve quality. As many as 72% of employees believe that it would improve work efficiency. They also present the impact of procedures on safety at work, reduction of stress factors, as well as reduction of waste and maximization of profits.*

Conclusions: *The presented data clearly shows that there is a need for procedures and quality improvement, both among employees as well as owners and managers. Specific procedures allow to increase the level of employees' security, ensure the quality of services provided and ameliorate the flow of information in the enterprise. All these benefits support the creation of a holistic and cross-sectional tool that would include all procedures and quality improvement that would systematize the work of dental offices.*

Key words: *quality management system, procedures of conduct, dentistry*

Introduction

In the coming years, the dynamic growth on the dental services market will be caused by the growing health awareness as well as the need for improving the aesthetics of a smile of Poles [1]. In order to have their expectations met, Poles visit private dental offices. The Polish dental market is still very fragmented compared to the market consolidation processes in the west [2]. According to the leading market research company PMR, the private sector is the driving force behind the dentistry market in Poland [3]. It is responsible for over 80% of all expenditures on dental services. For comparison, National Health Fund's expenditure on dentistry amounts to only about 2% of the Fund's budget [4]. Due to the under-financing, poor service quality, limited service package and several-month waiting periods for an appointment, the vast majority of patients use the services of approx. 6,000 private dental offices operating on the Polish market. Research by CBOS (Public Opinion Research Center) shows that private sector services are chosen by 69% of patients against 31% of those who receive treatment under contracts with the NHF. Therefore, dentistry remains the only branch of medicine in which Poles mostly rely on private services [5]. Additionally, the dental services market is one of the fastest growing medical services markets in Poland. It is estimated that patients will spend PLN 15.6 billion on dental services in just two years [6]. This significant increase in costs will allow the owners to develop quality solutions in the management of dental offices, offering them greater opportunities to compete in the private services sector. To this aim, one of the most significant changes will be the adaptation of the quality management system [7]. The quality management system is a set of guidelines that facilitate the management of a company, in this case a dental office [8]. A dental office is nothing more than a small enterprise that needs to be managed efficiently, whose employees and owners need to take care of procedures, regular supplies, quality of services and customer satisfaction [9]. Running a dentist's office entails assuming the role of not only a doctor, but also an entrepreneur, a marketer, a driver, and a supplier. Specific procedures help the owner to fulfil these roles. They allow the automation of activities

which save time and maximize the efficiency of the enterprise. In the example of dental offices, this relationship is even more true as for almost half (46%) of the dentists surveyed the main workplace was their own medical practice, for every fourth doctor (25%) it was a medical entity, and for every fifth respondent (20%) it was practice in such an entity [10]. It is also true that hiring managers to manage dental practices is gaining popularity, but it is not a common practice yet. The vast majority of dental clinic's owners are attending physicians, managers and entrepreneurs who also struggle with administrative obligations. Management procedures can streamline these tasks and thus allow the clinician to spend as much time as possible attending to patients [11]. The aim of the study is to assess the demands (of dental clinics' employees and owners) in terms of the quality management system. Due to the free-market nature of the surveyed entities and the lack of strictly defined requirements for quality management by the authorities, all pro-quality changes shall depend entirely on the owners and employees of private doctor's offices. Patients, as final recipients of services, may of course exert an influence on the owners of facilities, which would increase the facilities' competitiveness, but ultimately the patients' task is only to assess the quality of the services provided. This study is the first attempt to holistically approach the issues related to quality management in dentistry and the analysis of the demand for pro-quality solutions among owners and employees of dental clinics. Therefore, the research may be referred to as innovative one.

Current market situation

ISO standards can be applied and implemented in almost any organization, regardless of its size and type. Dental offices are no exception. ISO standards are basically universal standards that can and should be adapted to one's own needs, goals and intentions. Their ease of implementation is due to the fact that they are not of a technical nature. In terms of quality management systems, the ISO 9001: 2015 standard (Quality Management System requirements) is in accordance with the Polish designation

of the Standardization Committee, which is PN-EN ISO 9001: 2015 [12]. There are also standards compliant with ISO 14001 – environmental management, ISO / TS 27001 – Information security management, PN-N- / OHSAS 18001 – Occupational Health and Safety management. However, the discussion cannot be focused only on the benefits of implementing ISO standards, such as: increasing the quality of medical services provided, ensuring the trust of patients and cooperating companies and institutions, improving the functioning of the company, improving the flow of information within the company, and increasing transparency of rules and procedures which translates into increased competitiveness on the market and reduces the costs of the entity's operation [13]. There is one major drawback to ISO standards, and that is the price. The price of obtaining a certificate issued by a facility accredited by the Polish Committee for Standardization and the comprehensive implementation of the standard in the facility often exceeds PLN 10,000. It is estimated that maintaining the ISO certification in the office costs about PLN 600–700 per month, as calculated over a period of 3 years [14]. In addition, the certificate is limited in time and it must be renewed, which generates additional costs for the facility. For this reason, small dental offices – and most dental offices in Poland are in fact small – rarely undertake the venture of certifying their clinic. Most often, it is the domain of large market players or more popular dental clinics. Moreover, in 2015, the National Health Fund completely removed the requirement for dental clinics to obtain ISO certificates, thus further reducing the certificate's attractiveness even for public entities.

Inadequateness to reality

However, it is important to understand why ISO standards are so unsuited to dental offices on the Polish market. Firstly, it results from the fact that the most popular legal form of practicing the profession of a dentist is individual medical practice – carried out by almost 60% of doctors. Out of that, 70% clinics are usually equipped with only one dental unit. The average number of units in the office is 2.2 [15] (Figure 1).

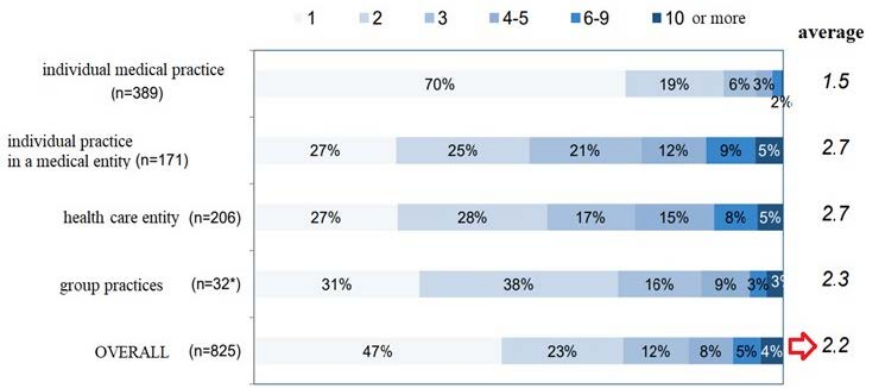


Figure 1. Number of dental units at the main workplace [26]

Accordingly, these are mostly small or medium-sized dental offices for which the cost of certification and its maintenance is definitely too high. Secondly, the reason why being ISO certified is not very popular among the owners of dental offices in Poland is the low awareness of the potential benefits of obtaining such a certificate. It is no wonder, since most of the owners are dentists who were not educated in the field of management and administration in the course of their studies, and who turned into entrepreneurs due to the fact that they own a practice, whether to their liking or not [16]. Consequently, if the doctors – clinic owners do not seek this knowledge on their own, it is of no surprise that they do not notice the benefits of certifying their facilities. It is also understandable for a more prosaic reason. Doctors see the benefit of buying a new endometer, which directly translates into an improvement in the quality and accuracy of the performed root canal treatment; they see the benefit of buying an X-ray machine as it allows for more accurate diagnostics and increases the attractiveness of the clinic. Unfortunately, the benefits of ISO procedures are not immediately visible and only after their meticulous implementation and compliance it will be possible to achieve the expected results, such as increasing efficiency, enhancing the level of safety, or maximizing the employee efficiency [17]. However, for dentist who are considered knowledge workers these benefits may not be so readily apparent and do not provide a sufficient incentive to invest capital in certifying their facility [18].

Procedures currently in place

However, there is an indicator that doctors, office owners and managers employed in dental clinics understand the importance of ISO-related procedures, even if not in the form of an official certificate or external quality confirmation [19]. It is the fact that they themselves create procedures for their own use and needs. But why is it the case? The main reason for such behaviour is the need to structure work and create certain standards so that, regardless of who does the work, the work is always done in the very same way [20]. For instance, if standards and procedures for instrument decontamination and sterilization are in place, regardless of whether it is performed by an assistant with 20 years or 2 months of experience, the instruments will be disinfected in the same way. This allows saving time during the induction of new employees and guarantees a constant standard of the services provided [21]. Procedures to be followed are nothing more but behavioural scenarios. Such repeated scenarios become habits, and habits become daily practice. This explains why dental clinics' owners and doctors create their own procedures that increase safety, save time and eliminate possible human errors when the work is not systematized [22]. However, it causes a significant problem of diversifying the procedures proposed. There are offices that have procedures in place for everything that happens in the clinic. There are facilities that only apply certain rules for dental procedures and disinfecting tools and spaces – they are the most numerous group due to the repercussions related to the COVID-19 pandemic [23]. Unfortunately, there are also dental offices that do not have any procedures in place. It is most often due to the fact that small clinics, e.g. single-station facilities with one assistant who is also a receptionist, see no need to create a procedure for a team of 2–3 people. However, it is not always the right decision. In other cases, the problem is also that each dental office has its own procedures – the ones that work specifically for them. At first glance, it does not seem to be a problem, but since there is a certain standard, for example for filling the canal in endodontic treatment or class II cavity preparation, and it is the current standard in force in dentistry according to the latest medical knowledge recognized in the scientific community, it would be possible to present procedures for each activity in a dental office. The procedures to

be followed may apply to arranging patients' appointments for treatment continuation, placing orders for materials, cooperating with a technician, or dealing with difficult patients or life-threatening situations [24]. Of course, slight changes are possible, depending on the structure or nature of the facility, but a general template of procedures may be such a gold standard in dentistry [25].

However, in order for an undertaking to create such a book of procedures to be successful, it would be necessary to first ask for the opinion and demand of those whom the book will be addressed to. Itis very often the case that in the rush of changes we forget ourselves and do not exercise due diligence to find out whether the proposed solution will have a sufficient number of supporters. In the private sector, researchers cannot afford the initial underestimation of the demand for the changes that are proposed.

Results analysis

In the first place, the analysis shall concern the responses from the questionnaire addressed to the employees of dental offices. Among our respondents, almost 41% were assistants and hygienists, 39% were dentists and the remaining 20% were medical recorders. The data is presented in Figure 2.

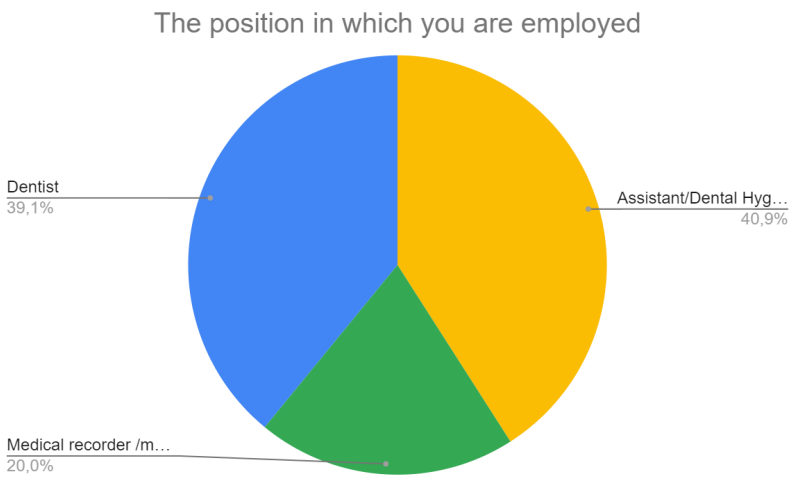


Figure 2. The structure of employment among the respondents

Source: Author's own study.

The average age of the respondents was 38. At the very beginning of the questionnaire, the respondents were asked a few side questions for the author to determine the level of employees' satisfaction with their work. One of the first questions was about salary satisfaction, "Are you satisfied with the remuneration structure and remuneration management system in your workplace?". In the response to this question, on a five point scale, 80% of respondents awarded 4 points, and only 14% gave 1 point. Another question was related to the atmosphere in the workplace. On a five point scale, 71% of interviewees awarded 5 points, 11% rated the working atmosphere at 4, and only 3% assessed it with the lowest value, i.e. 1. The respondents were also asked to assess their satisfaction with the office equipment. As many as 64% of them rated it as 5 in this survey, 20% rated the equipment of offices as 4, while only 7% rated it as 1. In the further part of the study, the staff evaluated cooperation with doctors, assistants, and registration employees. The respondents assessed satisfaction with the cooperation with doctors in the office on a five point scale. 86% rated it as 5, while the remaining 14% rated the cooperation as 4. Satisfaction with the cooperation with a registration employee was assessed on the same scale. 72% of respondents rated this cooperation at 5, 22% of them at 4, and the remaining 6% at 3. Cooperation with assistants/hygienists in the clinic was another evaluated factor. 50% of respondents rated the cooperation at 5, 43% – at 4, and 7% of employees rated it at 2. The last for of cooperation assessed was the cooperation with the facility owner/manager. 65% of respondents rated their satisfaction with such cooperation at 5, 29% of them at 4, and the remaining 6% assessed it as 3.

The following section of questions dealt with safety at work and procedures and quality improvement. In the question regarding safety in the workplace, 42% of the respondents rated it at 5, and the very same number at 4. The remaining 16% of responses were equally divided between the ratings of 3 and 2. Nobody rated safety in their workplace as 1. The next question was directly related to the procedures applied. The responses to this question are presented in Figure 3 and 4.

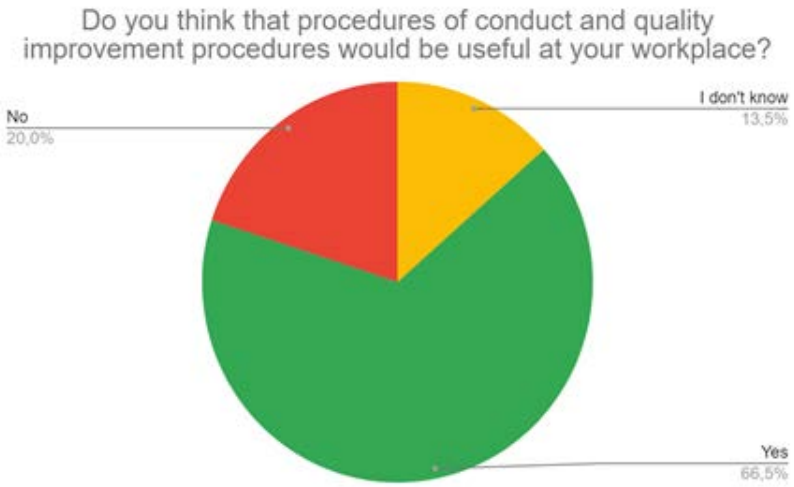


Figure 3. Usefulness of the procedures of conduct and quality improvement in the workplace

Source: Author's own study.

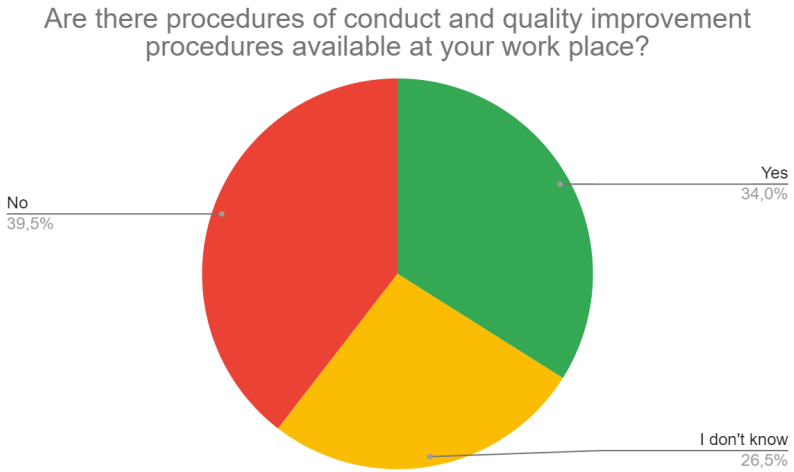


Figure 4. The current situation concerning the possession of procedures for the conduct and quality improvement in the workplace

Source: Author's own study.

As can be observed, 66% of respondents believe that it would be useful to have procedures to be followed in their workplace. However, only 34% currently have some sort of procedure and quality improvement system in their daily work. Interestingly, when asked if the employees would like to be responsible for creating the procedures of conduct and quality improvement system in their workplace, the votes were split equally (50%-50%). Additionally, 72% of respondents believe that their work would be performed more effectively if all employees in this position performed it in the same way. The remaining 28% considered it irrelevant. The following questions concerned meetings with the staff to provide details on the flow of information in the clinic, which improves the implementation of all changes. The data concerning such meetings is presented in Figure 5.

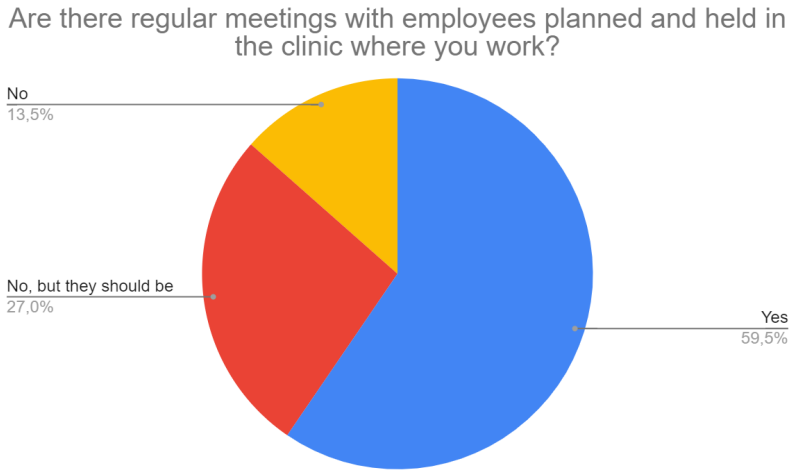


Figure 5. Regularity of meetings with employees

Source: Author's own study.

59.5% of employees declared that regular meetings are held in their workplace, which promotes the flow of information and allows for more efficient implementation of changes. Quality improvement is possible thanks to the systematic assessment and evaluation of progress. Therefore, the following questions focused on the assessment of employees and the entity itself. The results are presented in Figures 6 and 7.

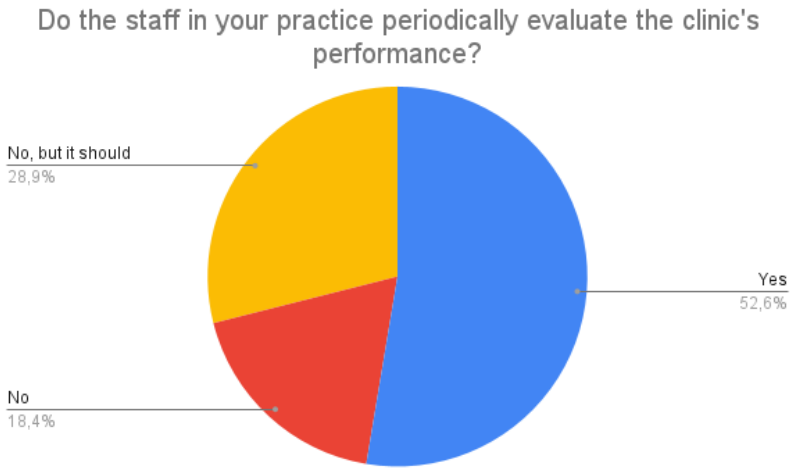


Figure 6. Systematic evaluation of the clinic by the staff – employees' responses

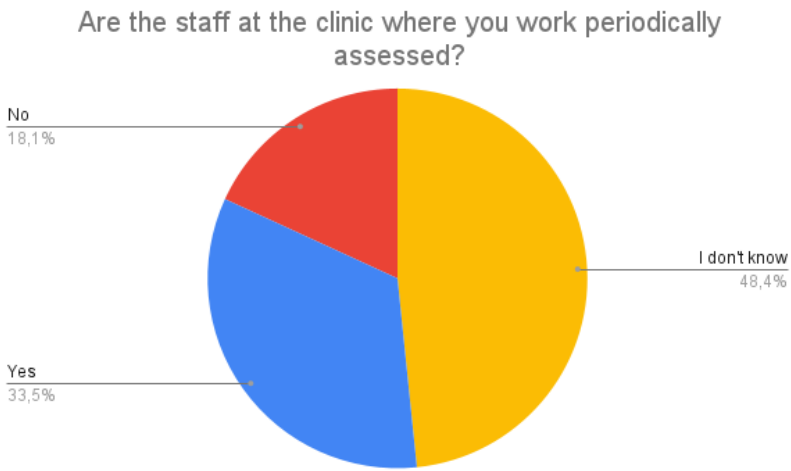


Figure 7. Systematic evaluation of the staff by the owner/manager or other staff representatives – employees' responses.

Source: Author's own study.

Only 53% of the respondents regularly assess the functioning of the clinic, and only 33% of the staff are regularly assessed. It means that there is low responsiveness to change and staff often do not have a benchmark for

improving performance. However, the most important question in the entire questionnaire was what procedures and quality improvement would be considered most needed by employees in their workplace. The answer to this question will allow us to determine which of the procedures introduced are the most important. Out of 22 procedures for the conduct and quality improvement, 6 were selected that were the most frequently mentioned. The answers were as follows:

1. Procedures for dealing with a "difficult" patient
2. Procedures for using individual equipment
3. Procedures for registering patients to continue treatment
4. Procedures for reporting problems and equipment/system malfunctions in the clinic
5. Procedures for handling life-threatening situations
6. Procedures for handling warranty claims and complaints

The second questionnaire was addressed to the owners and managers of dental clinics, and the answers provided in it were as follows: In the first question, the owners/managers were asked if they saw the benefits of introducing procedures and improving the quality in their office. The answers to this question provided in the questionnaire are presented in Figure 8.

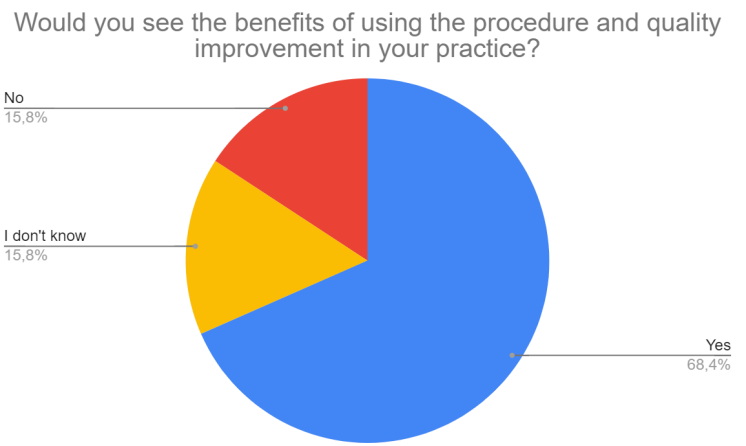


Figure 8. Potential benefit of implementing procedures and quality improvement

Source: Author's own study.

Almost 70% of respondents understand the benefits of introducing pro-quality solutions in their dental offices. This proves that there is a relatively high demand for such a type of procedure. In addition, there is a margin of almost 16% of respondents who are not convinced, but with an appropriate presentation of the benefits, they could become the supporters of this type of solution. Then the owners/managers were asked if there are already any procedures and quality improvement in place in their offices. Only 37% of respondents admitted that there are currently some procedures in place in their dental offices (Figure 9).

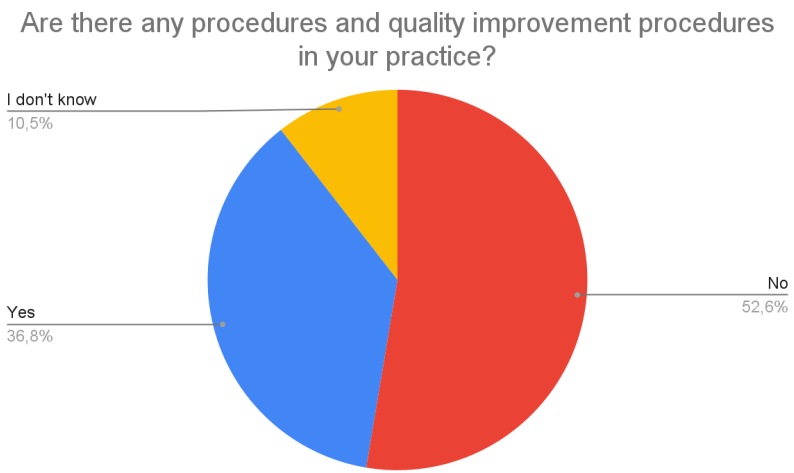


Figure 9. The current situation concerning the possession of any procedures in the dentist's office

Source: Author's own study.

Another important question is the allocation of responsibilities and who should actually be responsible for creating the procedures in the office. The answers to this question provided by the respondents are presented in Figure 10.

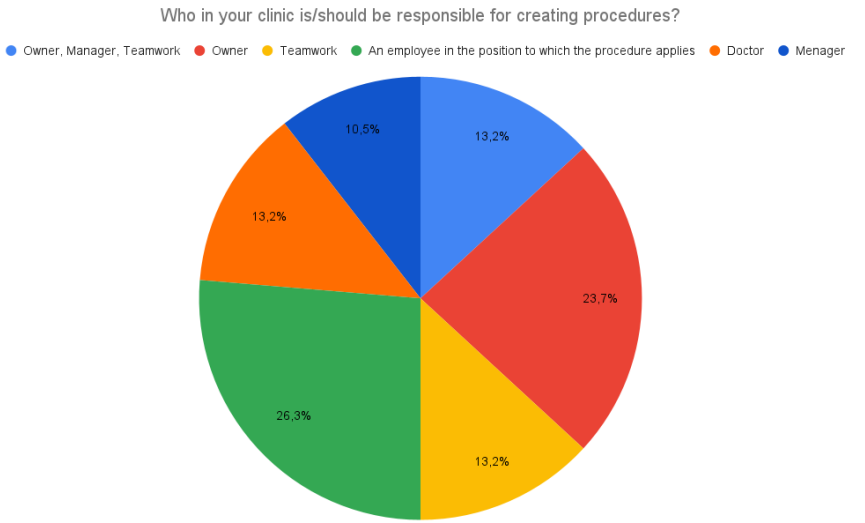


Figure 10. Responsibility for creating the procedures of conduct and quality improvement in the workplace

Source: Author's own study.

The most frequently selected answer was the one indicating the employee involved in a specific procedure, as well as the one saying that creating the procedures should be teamwork. 24% of the respondents feel that the owner should be responsible for creating workplace procedures. Subsequently, the owners/managers were also asked whether they assess their employees periodically and whether the employees are given the opportunity to evaluate the facility and its actions for employees. The answers to these questions are presented in Figure 11 and 12.

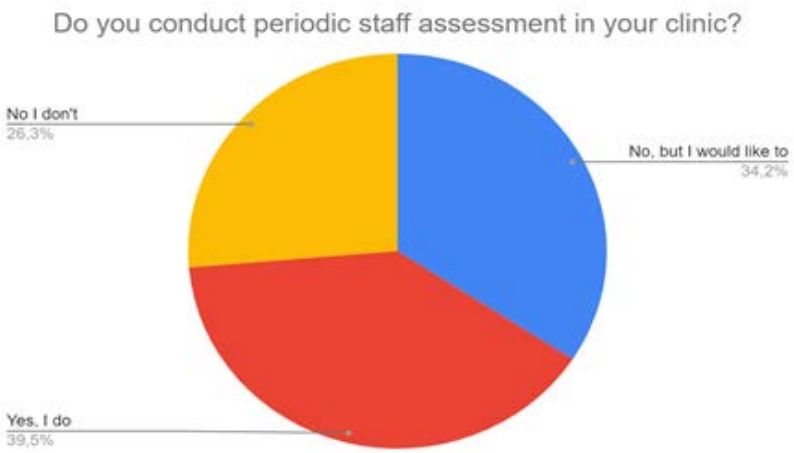


Figure 11. Systematic evaluation of the clinic by the staff – owner's/manager's responses

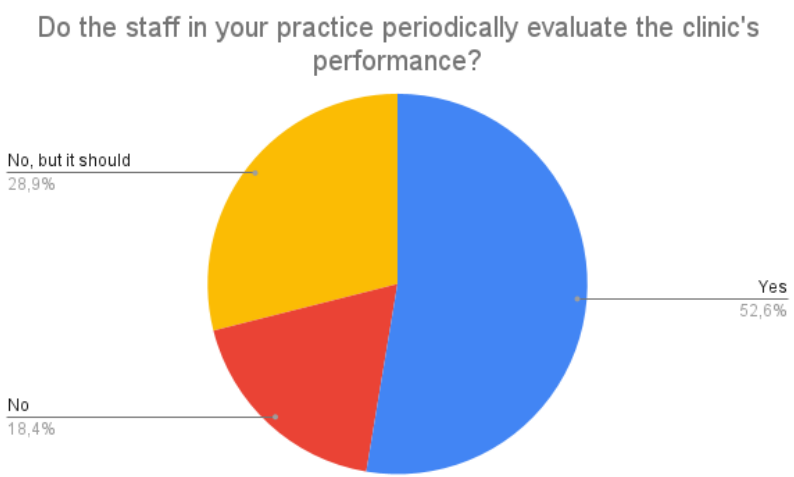


Figure 12. Systematic evaluation of the staff by the owner /manager or other staff representatives – owner's/manager's responses

Source: Author's own study.

Only 40% of owners/managers carry out systematic assessments of their employees, but almost twice as many declare their willingness to carry out such assessments. On the other hand, over 50% of respondents give the employees the opportunity to carry out systematic assessments of the facility's activities, which allows for the clinic's development. The last but one question was whether regular meetings are held in the offices, which allows the staff to assess the flow of information in the office.

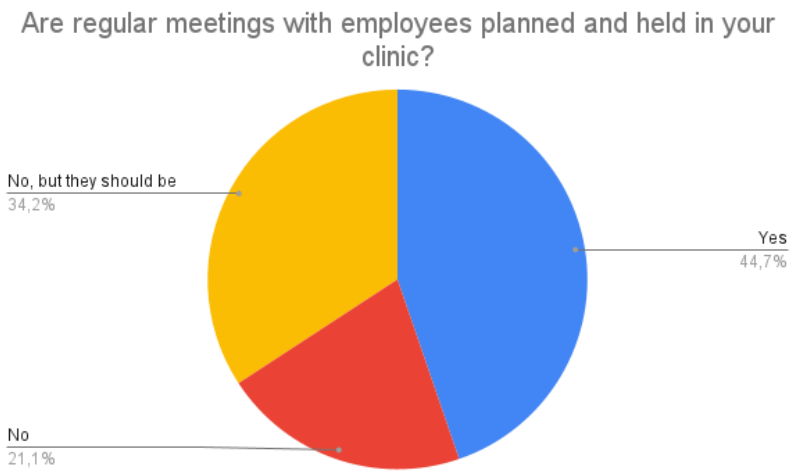


Figure 13. Regularity of meetings with employees – owners'/managers' responses

Source: Author's own study.

The owners/managers of the clinic were asked the same question concerning the regularity of meetings. Only 45% of respondents admitted that regular meetings with employees take place in the office. What is promising is the fact that over 34% of the interviewees declared their willingness to introduce such regular meetings to their daily work, which would improve the flow of information in the office and strengthen all the changes introduced. The last question was the same as in the employee questionnaire: The owners/managers were asked to choose the procedures they believe would be most necessary for their dental practice. Out of the 22 provided, 6 most frequently mentioned responses were selected, and the results are presented below.

1. Procedures for dealing with a "difficult" patient
2. Procedures for handling warranty claims and complaints
3. Procedures for reporting problems and equipment/system malfunctions in the clinic
4. Procedures for using individual equipment
5. Procedures for dealing with patient complaints made to various authorities
6. Procedures for registering patients to continue treatment

Discussion

The issues related to the improvement of quality play a significant role in the health care sector. The conducted study confirms the need for such improvements in dentistry. It draws attention to them from the perspective of the owners of private offices and their employees. Another important aspect to discuss when expanding and deepening the topic is the patient's perspective on quality improvement. Certainly, it shall be the author's next step in the research concerning dental quality management systems. The aspect requiring additional attention is creating a generally available database of procedures that require standardization for operational purposes. An overall study allows the researcher to evaluate the demand for a holistic and cross-sectional quality management system in dental clinics in Poland.

Conclusions

The presented data clearly shows that there is a need for procedures and quality improvement, both among employees as well as owners and managers of dental offices. Moreover, there was a catalogue of most needed procedures in clinics established, starting with the *procedures for handling "difficult" patients, through the procedures for handling warranty claims and complaints, work procedures of each group of staff, instrument decontamination procedures, equipment maintenance procedures, up to the procedures for handling patient complaints made to various authorities*. These are the procedures

that are the most stressful for the staff and, without proper tools, they can cause a decline in employee productivity or even burnout. In addition, clearly formulated and structured procedures would increase the effectiveness of the dental office and reduce waste, thus contributing to the increase in the company's profits. Other benefits include improving the employees' safety, enhancing the quality of services provided and streamlining the flow of information in the enterprise. All these benefits result from the creation of a holistic and cross-sectional tool that would include all procedures and quality improvement systems to systematize the work of dental offices.

References

1. Wapniarska K, Buła K, Hilt A. Parent's pro-health awareness concerning oral health of their children in the light of survey research. Przegl Epidemiol 2016; 70(1) [Internet]. Available from: https://pubmed.ncbi.nlm.nih.gov/27344476/ [cited 16 September 2022].

2. Rynek usług stomatologicznych w Polsce na etapie konsolidacji. Dentonet [Internet]. Available from: https://dentonet.pl/rynek-uslug-stomatologicznych-etapie-konsolidacji/[cited 16 September 2022].

3. Analiza rynku stomatologicznego – analiza rynku [Internet]. Available from: https://analizarynku.eu/rynek-stomatologiczny [cited 16 September 2022].

4. Rynek usług stomatologicznych w Polsce wart 8,6 mld zł. Dentonet [Internet]. Available from: https://dentonet.pl/rynek-uslug-stomatologicznych-w-polsce-wart-86-mld-zl/ [cited 16 September 2022].

5. Centrum Badania Opinii Społecznej. Znak jakości przyznany CBOS przez Organizację Firm Badania Opinii i Rynku 14 stycznia 2016 roku [Internet]. Available from: http://www.cbos.pl [cited 16 September 2022].

6. Rynek usług stomatologicznych wzrośnie do 16 mld zł. Medycyna Prywatna [Internet]. Available from: https://medycynaprywatna.pl/rynek-uslug-stomatologicznych-wzrosnie-w-2024-roku-do-prawie-16-mld-zl/ [cited 16 September 2022].

7. Crisan EL, Covaliu BF, Chis DM. A Systematic Literature Review of Quality Management Initiatives in Dental Clinics. Int J Environ Res Public Health 2021 Nov 1; 18(21) [Internet]. Available from: https://pubmed.ncbi.nlm.nih.gov/34769604/ [cited 16 September 2022].

8. Goetz K, Hess S, Jossen M, Huber F, Rosemann T, Brodowski M, et al. Does a quality management system improve quality in primary care practices in Switzerland? A longitudinal study. BMJ Open 2015; 5(4).

9. Zabada C, Rivers PA, Munchus G. Obstacles to the application of total quality management in health-care organizations. Total Quality Management 1998; 9(1): 57–66.

10. Ile pracują lekarze i lekarze dentyści w Polsce? – Raport z badań opinii środowiska lekarskiego. Ośrodek Studiów Analiz i Informacji. Warszawa, 2018.02 [Internet]. Available from: https://docplayer.pl/144426864-Ile-pracuja-lekarze-i-lekarze-dentysci-w-polsce-raport-z-badania-opinii-srodowiska-lekarskiego.html [cited 22 September 2022].

11. Ojha D, Aravamudhan K. Leading the Dental Quality Movement: A Dental Quality Alliance Perspective. J Calif Dent Assoc; 2016 Apr; 44(4): 239–244 [Internet]. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27265980 [cited 16 September 2022].

12. Turner C. Interdental brushes and ISO standards. Br Dent J. 2022 Jun 10; 232(11): 761–762 [Internet]. Available from: https://pubmed.ncbi.nlm.nih.gov/35689041/ [cited 16 Sptember 2022].

13. Bittar OJ. Administrative Processes and quality of health certification. Rev Assoc Med Bras (1992) 1999; 45(4): 357–363.

14. ISO w gabinecie stomatologicznym – Jak nie utknąć w kanałach przepisów [Internet]. Available from: https://prawodlastomatologow.pl/iso-w-gabinecie-stomatologicznym/ [cited 16 September 2022].

15. Naczelna Izba Lekarska. Lekarze Stomatolodzy 2016 – raport z badania. Warszawa; 2016, pp. 42–48. [Internet]. Available from: https://nil.org.pl/uploaded_files/1575629638_lekarze-stomatolodzy-2016-raport-z-badania.pdf [cited 16 September 2022].

16. Jones ML, Hobson RS, Plasschaert AJM, Gundersen S, Dummer P, Roger-Leroi V, et al. Quality assurance and benchmarking: An approach for European dental schools. European Journal of Dental Education 2007; 11(3): 137–413.

17. Hillsman JT. Quality assurance in dentistry. J Am Dent Assoc 1978; 97(5): 787–790 [Internet]. Available from: https://pubmed.ncbi.nlm.nih.gov/281417/ [cited 16 September 2022].

18. Grocock R. Leadership in dentistry. Br Dent J 2020 Jun; 228(11): 882–885 [Internet]. Available from: https://pubmed.ncbi.nlm.nih.gov/32541752/ [cited 15 September 2022].

19. Weintraub AM. Continuous Quality Improvement and Dental Practice: A Marriage of Necessity. The Journal of the American Dental Association 1996 Jul 1; 127(7): 1099–1106.

20. Goetz K, Campbell SM, Broge B, Brodowski M, Wensing M, Szecsenyi J. Effectiveness of a quality management program in dental care practices. BMC Oral Health 2014 Apr 28; 14(1).

21. Obadan-Udoh EM, Calvo JM, Panwar S, Simmons K, White JM, Walji MF, et al. Unintended consequences and challenges of quality measurements in dentistry. BMC Oral Health 2019 Mar 1; 19(1) [Internet]. Available from: https://pubmed.ncbi.nlm.nih.gov/30823894/ [cited 16 September 2022].

22. Cassie H, Mistry V, Beaton L, Black I, Clarkson JE, Young L. An evaluation of the implementation of quality improvement (QI) in primary care dentistry: a multi-method approach. BMJ Open Qual 2021 Apr 13; 10(2). [Internet]. Available from: https://pubmed.ncbi.nlm.nih.gov/33849904/ [cited 16 September 2022].

23. Scarano A, Inchingolo F, Lorusso F. Environmental Disinfection of a Dental Clinic during the Covid-19 Pandemic: A Narrative Insight. Biomed Res Int 2020 [Internet]. Available from: https://pubmed.ncbi.nlm.nih.gov/33145359/ [cited 16 September 2022].

24. Amundson CW. Dental Quality Measurement – A Practitioner Perspective. J Calif Dent Assoc 2016 Apr; 44(4): 233–237 [Internet]. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27265979 [cited 16 September 2022].

25. Sanazaro PJ. Quality assessment and quality assurance in medical care. Annu Rev Public Health 1980; 1: 37–68.

26. Dentists 2016 – study report, Supreme Medical Chamber. Warsaw; 2016 [Internet]. Available from: http://nil.org/uploaded files/1575629638dentists-2016-research-report.pdf.

Journal of Health Study and Medicine
2022, No. 2
pp. 29–41
DOI 10.36145/JHSM2022.09

Quality of Life of Patients over 65 Years Old Who Use Removable Dentures

Submitted: 30 June 2022 Accepted: 04 July 2022 Published: 30 December 2022

Urszula Papierz[1]
https://orcid.org/0000-0002-9015-1667

Agnieszka Żegota[1]
https://orcid.org/0000-0001-8324-4649

Anna Dudko[1]
https://orcid.org/0000-0002-0019-3151

Sebastian Kłosek[1]
https://orcid.org/0000-0001-9694-0950

[1] Department of Oral Pathology, Medical University of Lodz, Poland

Address for correspondence

Sebastian Kłosek
Department of Oral Pathology
Medical University of Lodz
251 Pomorska St.
92-213 Lodz, Poland
sebastian.klosek@umed.lodz.pl

Abstract

Background: *Elderly patients using removable dentures experience a number of oral problems associated with mucosal traumatisation and the consequences of poor oral hygiene, which affect the patients' quality of life.*

Objectives: *The aim of this study was to assess the quality of life associated with the oral cavity in patients over 65 years of age who use removable dentures.*

Material and methods: *A group of 98 patients over 65 years of age who use removable dentures were examined with the GOHAI questionnaire. Demographic data, and information on smoking, the duration of denture use and the Fox test were also taken. The dental examination assessed the condition of the oral cavity, especially missing teeth, approximal plaque index API, gingival bleeding index SBI, and prosthetic base.*

Results: *Sperman correlation analysis showed statistically significant differences in several variables. A statistically significantly lower quality of life was found in patients who were edentulous, smoked cigarettes, had symptoms of dry mouth, prosthetic base inflammation and SBI above 50%.*

Conclusions: *Patients using removable dentures mostly lack good oral hygiene, which needs to be improved by increasing their awareness of the possible consequences of neglect. Dental care should take into account factors that affect patients' quality of life.*

Key words: *quality of life, removable dentures, GOHAI*

Introduction

As a result of changes in the demographic structure of the population in Poland, the proportion of patients over 65 years of age is steadily increasing [1]. Due to increasingly better dental care, a large proportion of the elderly, also in Poland, retain their teeth into old age. The average number of retained teeth in people aged 65–74 years in Poland in 2002 was 6.3. However, the percentage of edentulous people in Poland is still high and currently exceeds 43.9% of the population [2, 5]. At the same time, there are significant differences in the percentage of edentulous people between different European countries. In western and northern European countries, the level of edentulousness is low, ranging from 5% to 8%. On the other hand, in Central and Eastern European countries, the percentage of edentulous elderly ranges from 40% in Poland and Slovakia, 53% in Bulgaria, 69% in Albania, to 78% in Bosnia and Herzegovina [3–5]. These people mostly use removable prostheses. Depending on the quality of the prosthesis and the duration of its use, patients face problems of discomfort in the oral cavity during chewing, swallowing and pronunciation, as well as in interpersonal contacts. Embarrassment about denture problems translates into impaired social interaction [7]. The first study to assess dental patients' quality of life on the basis of the General (Geriatric) Oral Health Assessment Index (GOHAI) was conducted by Atchison K. and Dolan T. in 1990 in the United States for the purpose of studying the elderly population. Since then, this index has been a frequently used tool to assess oral health-related quality of life, worldwide and in Poland [6, 7]. In subsequent studies, it has also been used in younger people, so both alternatives of the name, Geriatric and General (Geriatric/General), are correct [8, 9]. It describes elements of oral health in relation to quality of life related to physical functioning (eating, speaking and swallowing) and psychosocial functioning (feelings of anxiety about oral health, dissatisfaction with appearance, avoidance of social contact because of oral health problems, and feelings of oral pain and discomfort) [7]. The GOHAI scale consists of 12 questions concerning the last three months of life and can be used, among

others, to assess patient satisfaction with health care, to evaluate quality of life in relation to oral health in patients with general diseases or to monitor the effects of dental treatment [10, 11].

Objectives

The aim of this study was to assess the quality of life associated with the oral cavity in patients over 65 years of age who use removable dentures.

Material and methods

Approval was obtained from the Bioethics Committee of the Medical University of Lodz (RNN/341/18/KE) to conduct the study. The study was conducted at the Institute of Dentistry in Lodz over the following 6 months. The eligibility criteria for participation in the study were the patient's age above 65 years and the use of removable dentures. Participation in the study was anonymous, voluntary and started after obtaining the written consent of the participant. Ninety-eight patients were recruited consecutively during follow-up visits. Patients excluded from the study were those who did not sign a consent form [13]. The study included an interview, a clinical examination and questionnaires. In the interview, information on age, smoking, duration of use of previous prostheses, and willingness to undergo prosthetic treatment (fabrication of new prostheses) was obtained. In the clinical examination, the following oral deficiencies were assessed: inflammation on the prosthetic base according to Newton's classification, oral hygiene on the basis of API approximal plaque index and SBI gingival bleeding index. Dental deficiencies were assessed for 3 groups (edentulous, missing more than 10 teeth, missing fewer than 10 teeth). Prosthodontic stomatopathies were divided into 2 groups, the first included those which lacked inflammation or were classified as class I according to Newton, the other included those which were classified as class II and III according to Newton. In the questionnaire part, the Fox test to assess dry mouth and a questionnaire to assess the patients' quality of life were performed. Oral

health related quality of life (OHRQoL) was assessed using the Polish version of the GOHAI (Geriatric Oral Health Assessment Index) questionnaire. This has been validated by Rodakowska et al. [10]. Coding of questions: How often have you been able to swallow freely? (No. 3), How often were you able to eat all foods without discomfort? (No. 5), How often were you satisfied or dissatisfied with the appearance of your teeth, gums or dentures? (No. 7) was reversed [7]. GOHAI scores range from 12 to 60 points calculated on a Likert scale. Scores are interpreted as follows: below 50 points – poor quality of life, 51–56 points – moderate quality of life, 57–60 points – very good quality of life.

Perception of dry mouth was assessed using the 10-question (yes/no) Fox test. For the Fox test, it was assumed that a positive response to a minimum of 3 questions out of 4 key questions (i.e., question numbers 4, 5, 6, and 9), as well as a positive response to at least one other question out of 10 questions, could suggest the presence of dry mouth.

On the basis of the collected database, statistical analysis was performed using the STATISTICA program version 13.3 (TIBCO, Poland). Group differences for the ordinal variable were compared using non-parametric Mann-Whitney U tests for two groups and non-parametric Kruskal-Wallis tests for more than two groups. At a statistically significant global p for the Kruskal-Wallis test, a post-hoc analysis was performed using the Dunn test. Differences were characterised using the median and Q1 (25% quartile) and Q3 (75% quartile), as well as statistical significance p. Statistically significant results were additionally presented using box-and-whisker plots. Correlations for ordinal variables were performed using Spearman rank correlation. Statistical significance for analyses was assumed at the level of $p<0.05$.

Results

Ninety-eight patients with removable dentures were recruited for the study – 82 of them had teeth in the mouth, 16 were edentulous. The patients were divided into three age groups, the largest group N=61 was 65–74 years old. Fifty-seven women and 41 men participated in the study.

The study showed that tobacco-smoking patients had lower GOHAI scores (median=48 (Q1–Q3=39.00–49.50), p=0.035)) than non-smoking patients. Similar differences were found among patients with inflammation on the prosthetic base (median=48 (Q1–Q3=44.00–50.00), p=0.009) and among patients classified as having dry mouth according to Fox test results (median=48 (Q1–Q3=38.00–50.00)). In addition, the GOHAI scores were much lower in edentulous patients (median=38 (Q1–Q3=35.00–47.50), p=0.003)) than in patients with any dentition. For patients with ≤10 teeth or >10 teeth, there were no significant statistical differences, and the median along with Q1 and Q3 for the GOHAI scores was the same at 49.00 (48.00–54.00) (Table 1, Figure 1). Age, gender, duration of use of removable dentures or willingness to undertake prosthetic treatment did not show statistically significant differences in GOHAI scale scores.

Examination of the correlation between the PUW and patients' GOHAI scores revealed a lack of association between the factors (p-value for Spearman rank correlation =0.181).

Only patients who had dentition (N=82) were included in the analysis of differences between values obtained for API and SBI. The analysis showed no statistically significant differences between patients with different API, while statistically significant differences (p=0.019) were found between patients with different SBI. Patients with SBI 10–29% scored much higher on the GOHAI questionnaire (median=53.50 (Q1–Q3=50.00–56.00)) than patients with more advanced periodontal inflammation with SBI>50% (median=48 (Q1–Q3=47.00–53.00)). The results are presented in Table 2 and Figure 2.

Discussion

Publications on quality of life associated with oral health conducted in Poland and Central and Eastern Europe in patients using removable dentures are scarce. In a 2017 study by Rodakowska et al., a median score of 36 and a mean score of 35.56 were obtained in 100 patients using complete dentures in the GOHAI. There was a significant statistical correlation between GOHAI

and place of residence (rural vs urban) p=0.022 and dry mouth p=0.009 [13]. Galczynska-Rusin et al. in a study of patients treated with partial and complete removable dentures obtained results comparable to our study (median 48.2) [11]. In the patients studied, declared oral health problems were statistically significantly correlated with the place of residence, perceived dryness of the mouth, difficulty in chewing and low self-assessment of oral health [11]. In our study in patients using partial and complete dentures, we obtained similar results (median 48) in patients with partial dentures. In edentulous patients, the result was even lower (median 38). However, edentulous patients were a smaller group, which may have influenced the results. In 2010, Gerritsen et al. confirmed the relationship between tooth loss and poor oral health-related quality of life [12]. According to the authors, tooth loss has a strong negative effect on OHRQol, but a complete denture, or edentulous mouth improves oral health-related quality of life [12]. In our study, edentulous patients showed poorer quality of life compared to patients with missing teeth. Our results, like those of other authors, showed a significant correlation between GOHAI and smoking p=0.035, missing teeth p=0.003, prosthetic inflammation p=0.009, and dry mouth p=0.013. To confirm the data obtained, it would be advisable to repeat the study on a larger group of patients.

Conclusions

Patients using removable dentures showed a poor quality of life in the GOHAI index. The median score (25%–75%) for the various study factors mostly oscillated below 50 points. Significant statistical differences showed that the quality of life was worsened by smoking, dry mouth symptoms and advanced inflammation on the prosthetic base, as well as coexisting gingival bleeding (SBI above 50%). Very poor quality of life was also reported in the group of edentulous patients who used complete dentures. The above data should be taken into account when planning dental treatment in the elderly.

References

1. GUS. Sytuacja osób starszych w Polsce w 2020. Warszawa, Białystok; 2021.

2. Knychalska-Karwan. Anatomia i fizjologia narządu żucia u ludzi w podeszłym wieku. In Knychalska-Karwan Z. Stomatologia wieku podeszłego. Lublin: Wydawnictwo Czelej; 2005, pp. 1–21.

3. Polzer I, Schimmel M, Müller F, et al. Edentulism as part of the general health problems of elderly adults. Int Dent J 2010; 60(3): 143–155.

4. Zitzmann NU, Hagmann E, Weiger R. What is the prevalence of various types of prosthetic dental restorations in Europe? Clin Oral Impl Res 2007; 18: 20–33.

5. Jodkowska E, Wierzbicka M, Szatko F, et al. Monitoring zdrowia jamy ustnej. Polska 2009. Stan zdrowia jamy ustnej i jego uwarunkowania oraz potrzeby profilaktyczno-lecznicze dzieci i osób dorosłych w wieku 65–74 lat. Warszawa; 2009.

6. Slade GD, Spencer AJ. Development and Evaluation of the Oral Health Impact Profile. Comm Dent Health 1994; 11: 3–11.

7. Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. J Dent Educ 1990; 54: 680–687.

8. Tubert-Jeannin S, Riordan PJ, Morel-Papernot A, et al. Validation of an oral health quality of life index (GOHAI) in France. Comm Dent Oral Epidemiol 2003; 31: 275–284.

9. Atchison KA, Der-Martirosian C, Gift HC. Components of self-reported oral health and general health in racial and ethnic groups. J Public Health Dent 1998; 58: 301–308.

10. Rodakowska E, Mierzyńska K, Bagińska J, et al. Quality of life measured by OHIP-14 and GOHAI in elderly people from Bialystok, north-east Poland. BMC Oral Health 2014; 20(14): 106.

11. Gałczyńska-Rusin M, Koczorowski R, Sielska J. Linguistic adaptation and validation of the Polish version of the General Oral Health Assessment Index (GOHAI). J Stom 2014; 67(2): 152–165.

12. Gerritsen AE, Allen PF, Witter DB, et al. Tooth loss and oral health-related quality of life: a systemic review and meta-analysis. Health Qual Life Outcomes 2010; 8: 126.

13. Rodakowska E, Bagińska J, Jamiołkowski J, Cylwik-Rokicka D, Mierzyńska K, Fryc J. Skala Oceny Ogólnego Zdrowia Jamy Ustnej (GOHAI) u pacjentów użytkujących protezy całkowite. Gerontologia Polska 2017; 25: 112–117.

Tables

Table 1. Distribution of mean GOHAI scale values according to selected factors

GOHAI scale			
Factor		Mediana (25–75%)	p
Age	65–74 (N=61)	49.00 (47.00–54.00)	0.136
	75–84 (N=22)	48.00 (38.00–53.00)	
	>85 (N=15)	48.00 (34.00-50.00)	
Gender	Female (N=57)	49.00 (44.00–54.00)	0.871
	Male (N=41)	48.00 (47.00–53.00)	
Smoking	Yes (N=28)	48.00 (39.00–49.50)	**0.035***
	No (N=70)	49.50 (47.00–54.00)	
Missing teeth	Toothlessness (N = 16)	38.00 (35.00–47.50)	**0.003***
	≤10 teeth (N=10)	49.00 (48.00–54.00)	
	>10 teeth (N=72)	49.00 (48.00–54.00)	
Service life of removable dentures	>10 years (N=75)	48.00 (44.00–53.00)	0.281
	≤10 years (N=23)	49.00 (47.00–55.00)	
Interest in prosthetic treatment	Yes (N=39)	48.00 (40.00–54.00)	0.654
	No (N=59)	49.00 (46.00–53.00)	
Inflammation on the prosthetic base	Yes (N=47)	48.00 (44.00–50.00)	**0.009***
	No (N=51)	50.00 (47.00–55.00)	
Assessment of dry mouth by the Fox test	dry mouth (N=40)	48.00 (38.00–50.00)	**0.013***
	lack of dry mouth (N=58)	49.00 (48.00–55.00)	

*values <0.05

Table 2. Distribution of mean GOHAI scale values according to API and SBI

GOHAI scale			
Factor		Mediana (25–75%)	p
API (N=82)	<25% (N=6)	53.50 (50.00–57.00)	0.057
	25–39% (N=6)	53.50 (50.00–55.00)	
	40–70% (N=23)	49.00 (47.00–53.00)	
	>70% (N=47)	48.00 (47.00–53.00)	
SBI (N=82)	10–29% (N=12)	53.50 (50.00–56.00)	**0.023***
	30–50% (N=21)	49.00 (48.00–53.00)	
	>50% (N=49)	48.00 (47.00–53.00)	

*values <0.05

Figures

Figure 1. Difference in severity of GOHAI scores between A) non-smoking vs smoking patients (p=0.035); B) patients with ≤10 teeth vs edentulous (p=0.042) and patients with >10 teeth vs edentulous (p=0.002); (C) patients with inflammation on the prosthetic base vs patients without inflammation on the prosthetic base (p=0.009); (D) patients with indicated dry mouth vs no feeling of dry mouth based on Fox test (min 3 +1) (p=0.013).

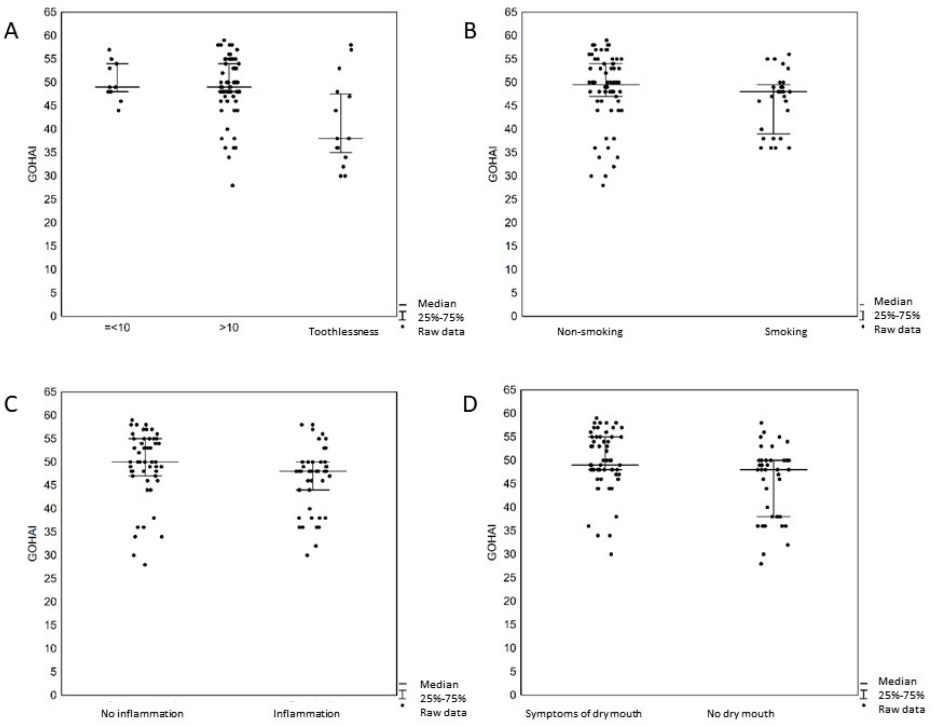
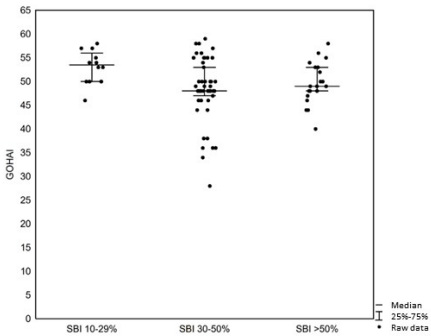


Figure 2. Differences in severity of GOHAI scores between patients with SBI 10–29% vs patients with SBI >50%.



Journal of Health Study and Medicine
2022, No. 2
pp. 43–67
DOI 10.36145/JHSM2022.10

Addictions in the Elderly – Review Article

Submitted: 06 July 2022 Accepted: 10 October 2022 Published: 30 December 2022

Adrianna Nieciecka[1]
https://orcid.org/0000-0001-5939-3388

Agata Wójcik[2]
https://orcid.org/0000-0002-8969-7312

Julia Tomys[1]
https://orcid.org/0000-0002-3467-2142

Kornelia Kędziora-Kornatowska[1]
https://orcid.org/0000-0003-4777-5252

Magdalena Lamch[1]
https://orcid.org/0000-0003-0749-8190

Marta Janiszewska[1]
https://orcid.org/0000-0003-3154-234X

Monika Jabłońska[1]
https://orcid.org/0000-0002-6076-6791

Natalia Błasik[1]
https://orcid.org/0000-0003-0488-1346

[1] Faculty of Health Sciences, Department and Clinic of Geriatrics, Nicolaus Copernicus University in Toruń, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Poland

[2] Department of Exercise Physiology and Functional Anatomy, Nicolaus Copernicus University in Toruń, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Poland

Address for correspondence

Adrianna Nieciecka
Ludwik Rydygier Collegium Medicum in Bydgoszcz
Nicolaus Copernicus University in Toruń
13–15 Jagiellońska St.
85-067 Bydgoszcz, Poland
adanieciecka4@gmail.com

Abstract

Background: *Society in Poland and other developed countries is aging at an increasing rate, which is also reflected in the frequency of addiction among older people. This has social, health and economic implications, as older people are still active in the labor force today.*

Objectives: *The aim of this study is to review information on the problem of addiction to drugs, nicotine, alcohol and gambling in the elderly and to present the related difficulties in medical practice.*

Material and methods: *Review of publications on addiction among seniors included in the PubMed and Google Scholar database. The publications were collected between 2011–2021.*

Conclusions: *Addictions in older people are slightly different from addictions in younger age groups, so they should be considered separately. The elderly are particularly vulnerable to drug addiction. Seniors suffer from many chronic diseases; polypharmacy is often used to treat them. In addition, older people often struggle with insomnia and pain, which can lead to addiction to benzodiazepines and opioids. The physician plays a key role in the diagnosis and treatment of addiction in elderly patients, regardless of the type of addiction. In all cases of addiction, factors that predispose seniors to addiction should be taken into account. These are often modifiable factors, such as loneliness, a sense of rejection or inappropriate treatment of chronic diseases.*

Key words: *alcohol, gambling disease, nicotine, aging, polypharmacy*

Introduction

The progressive aging of society makes health problems related to alcohol, nicotine, drug or gambling addiction in the elderly a more critical issue than before, not only because of the negative impact on health, but also due to the social and economic consequences. Addiction is a problem that affects people of all ages. The essence of addiction is the loss of control over thinking and behavior, which leads to the constant search for contact with the specific substance by an addict [1]. The problem of addiction does not only concern people on the margins of society. Although it may seem that it does not apply to the elderly, there are addicts over 60 years of age. Despite the fact that drinking alcohol decreases with age, it is still a fairly common problem. American screening of the primary care population showed that 15% of men and 12% of women over the age of 60 drink above the recommendations of upper consumption of the National Institute of Alcohol Abuse and Alcoholism [2]. It is worth emphasizing that Polish society is aging, so the problem of alcoholism will be increasing. A similar situation will occur in other developed countries.

The problem of smoking is associated with premature mortality, and therefore the proportion of smokers in the elderly population may be lower. The Centers for Disease Control and Prevention (CDC) reports that in 2017, approximately 8 out of 100 adults aged 65 and over smoked cigarettes [3]. It is estimated that smoking reduces life expectancy by an average of 10 years, contributing significantly to premature mortality, i.e. an increase in the number of deaths in the population before reaching the conventionally defined old age threshold [4]. Seniors also very often struggle with drug addiction, especially opioids or benzodiazepines. This is a very unfavorable phenomenon taking into account the decreased drug metabolism in the elderly and a common phenomenon of polypharmacotherapy. Older patients take 3 to 8 drugs on average [5].

It is estimated that in developed countries, approximately 30–40% of people over 65 years of age take 5 or more drugs, while 12% of patients in this age group use 10 or more different drugs [6]. These are usually drugs

prescribed by doctors for chronic diseases, but there are also drugs that patients themselves buy at a pharmacy without a prescription. In addition, it is worth bearing in mind that the elderly are often persuaded to buy a drug or supplement through advertising. Seniors often experience pain due to progressive degenerative disease, pathological fractures, cachexia or cancer, and this in turn causes them to take opioids in over-programmed doses and thus with greater side effects [3, 7]. In old age, insomnia is a common problem, hence the widespread dependence of the elderly on benzodiazepines, which are overused and prescribed almost without limit. In seniors, these drugs increase the risk of memory impairment, falls, fractures and car accidents as well as avoidable visits to emergency departments and hospitalization [8]. Gambling Disorder (GD) is a persistent symptom of gambling activity, which for the majority of the general population may be an intermittent hobby. The common forms are casino games, slot machines and lotteries. Online gambling has grown in popularity in recent years as more and more people have constant access to the internet. The prevalence of gambling around the world ranges from 0.12% to 5.80% [9]. In the elderly population, these values are similar, and the large discrepancy in the range results from the lack of standardization of the research. Considering the aging of the population, as well as the SARS CoV2 pandemic, which may have contributed to the increase in the number of addicts, it is necessary to focus on the problem of addiction among the elderly. Therefore, this article discusses the most common addictions in seniors, their causes, consequences and ways of dealing with the problem.

Predisposing factors

Many factors contribute to the emergence of substance addiction disorders or behavioral disorders among the elderly. Some personality traits may increase the risk of addiction, e.g. impulsivity, low self-control and higher neuroticism. Due to the fact that risky behaviors make it easier to cope with anxiety, anger and low mood, negative emotionality also increases the likelihood of developing addiction [10]. An example of a tool used to assess

the relationship between specific personality traits and the type of addiction is the Minnesota Multiphasic Personality Inventory, the criteria of which include the presence of hysteria, anxiety, defensiveness, ego strength or hypochondria among the respondents. Also, personality disorders such as borderline personality disorder or antisocial personality disorder positively correlate with the tendency to use stimulants [11].

Social factors also play an important role in the emergence of addiction. The aging process is associated with numerous changes in this area of life, such as retirement, deterioration of health, and death of a spouse or other family members and friends. The aforementioned events contribute to the feeling of loneliness and social isolation among the elderly [12]. Due to their decreasing ability to control various life circumstances, the elderly may seek the feeling of control in the predictable feelings that accompany substance use [13].

According to a study conducted on the Polish population with the participation of people aged 60 and over, the COVID-19 pandemic also increased the number of elderly people feeling lonely and suffering from depression or anxiety disorders. Moreover, the feeling of loneliness was more intense in people living alone compared to those living with their family or partner, and the widowed and singles compared to people living in relationships. The feeling of loneliness is presented as a factor predisposing individuals to both mental and physical disorders, as well as increasing the risk of death [14].

Another study showed that single people, whether widowed, divorced or single, presented a greater severity of problems associated with gambling. For some older people, gambling was associated with the possibility of socializing with peers or family, and interestingly, people who were driven by a social motive showed a lower degree of addiction than people who treated it as a way to cope with loneliness. Moreover, living with children or a spouse was a factor protecting against risky behavior [12].

A characteristic feature of the elderly population is multi-morbidity, which is associated with chronic pain, polypharmacy and frequent hospitalizations may be associated with a tendency to abuse drugs such as benzodiazepines [15]. It is worth noting that with age, the likelihood of side effects

related to substance abuse also increases, because the hepatic metabolism changes in the aging process, and moreover, older people take more OTC drugs than people in younger age groups, which also increases the risk of interactions [15, 16]. Drug abuse may also result from a lack of knowledge and understanding of how a given drug should be taken [17]. Other factors that increase the risk of addiction in later life include male gender, secondary or lower education, lack of religious activity, stay in a long-term care facility or substance abuse earlier in life [17, 18].

The coexistence of many diseases also makes it difficult to distinguish symptoms of substance abuse from symptoms of depression, anxiety or complications of medical interventions. Also, the fact that the elderly usually abuse substances in their own home, drive vehicles less frequently and are professionally active reduces the likelihood of anyone in their environment noticing a problem [16].

Prescription drug addiction

Alcohol, opioids, and sedative and hypnotic drugs are the most common substances abused in the group of older adults [5, 19]. Drug abuse can be associated with a variety of circumstances. It can be initiated by inappropriate medication use, which over time may lead to its abuse. Conscious misuse of drugs, taking them in higher doses than recommended or mixing with alcohol is a much rarer phenomenon among the elderly [5]. Polypharmacy may play an important role in the use of psychoactive drugs by the elderly. In the study involving 3000 people aged 57–85, over 80% of the patients used ≥1 prescription drug daily and almost half of them used ≥5 drugs simultaneously [3]. According to the Drug Abuse Warning Network data from 2008, 61% of adverse effects of drugs occurred in people ≥65 years of age, while 25% of these episodes resulted from drug effects on the central nervous system [19].

It is important to understand that the metabolism of opioids and benzodiazepines differs between young and elderly subjects. Due to the decrease in both hepatic and renal function in the elderly, there is a risk of drug accumulation and its increased toxicity.

Benzodiazepines are very often used by the elderly and as many as 25% of all prescriptions for benzodiazepines are issued to people over 65 years of age. Moreover, in this age group benzodiazepines are often used for longer periods of time and the therapy is usually less controlled than in younger patients. Among the elderly, the daily use of these drugs for at least six months applies to up to 20% of patients. A quarter of the elderly patients have been taking benzodiazepines for more than a decade. As many as 30–40% of older adults in nursing care facilities use benzodiazepines. In the elderly, benzodiazepines are indicated primarily for short-term use in the treatment of anxiety and sleep disorders. The harmful, long-term use of these drugs often applies to patients with sleep and anxiety disorders as well as dementia. The dependence on benzodiazepines in the elderly may affect up to 20% of hospitalized patients and 30% in those diagnosed with depression, and it usually remains undiagnosed and therefore untreated. Benzodiazepine dependence in the elderly is usually characterized by constant intake of small doses of these drugs for a long period of time, and the development of tolerance and dose escalation are not common [20]. This is caused by decline in drug metabolism and its accumulation. However, the symptoms of addiction, including withdrawal syndromes, are observed in 50 to 100% of patients using benzodiazepines for a long period of time. Data on the treatment of dependence indicate that a withdrawal of substitute doses of benzodiazepines in patients ≥65 years of age is possible at a similar time as in younger people [21].

In 2008, opioid misuse was responsible for the largest number of deaths attributed to drug overdose. Due to the greater prevalence of pain, elderly patients are more likely to be prescribed opioids [22]. It is estimated that between 1992 and 2003, the number of Americans abusing prescription opioids increased from 7.5 million to 15.1 million. What is more, between 2000 and 2010, the number of accidental overdoses of prescription opioids increased almost four times [23]. According to estimates from 2005, the number of problematic opioid users in Poland was in the range of 25,000–29,000 people. In 2009, it was estimated that this problem affected 10,400–19,800 people in Poland. This suggests that the number of problematic opioid users in Poland decreased over the 4 years. A similar tendency has been observed

in most European countries [24]. Pain relief remains a primary motive for opioid abuse in older patients. Misuse of opioids is much less frequently caused by factors unrelated to pain management than in younger age groups [7].

The use of benzodiazepines and opioids in older adults may be associated with a number of risks, mainly cognitive and psychomotor impairment (Table 1). Long-term use of these medications increases the risk of fractures, traffic accidents and falls (Table 1) [22]. Benzodiazepines adversely affect cognition and increase the risk of dementia (Table 1). In patients with affective disorders and psychoses, benzodiazepines make the diagnosis of these diseases difficult and negatively affect their natural course [20].

A delayed diagnosis is a significant and common problem in addiction in elderly patients. Many complications of drug abuse in the elderly are explained by the patient's old age [21]. Addiction may have a similar clinical presentation to dementia or depression [22]. Late diagnosis may also be influenced by the fact that cases of substance abuse in older adults differ from the typical presentation of addiction in younger subjects. They use small, constant doses of medications for a long time and do not show the typical features of psychological dependence [20].

Alcohol

Alcohol Use Disorder (AUD) among elderly patients is a significant clinical problem because the effects of alcohol harm on the body of the elderly are much more severe than in the case of young people. As recommended by the National Institute on Alcohol Abuse and Alcoholism (NIAAA), both women and men over the age of 65 should not consume more than 1 standard drink daily or 7 standard drinks weekly. It is estimated that alcohol problems among the elderly concern 10–15% of patients in primary health care, 30% of patients hospitalized in general departments and approximately 50% of patients in psychiatric wards [25]. With age, muscle mass decreases and adipose tissue mass increases at the same time, which means that the high level of alcohol in the body persists longer. This is also caused by the reduced liver function, which hinders removing alcohol from the blood [2, 26]. Moreover, the neurons

of elderly patients are more susceptible to the toxic effects of alcohol. It is estimated that dementia is found in up to a quarter of seniors hospitalized due to alcohol addiction [2]. Alcohol also increases the risk of liver cirrhosis, pancreatitis, diabetes, osteoporosis, atherosclerosis, heart attack and cancer [26, 27]. Elderly patients may present atypical withdrawal symptoms with confusion predominant (Table 1). The onset of symptoms often begins several days after stopping drinking, and complications such as convulsions and delirium are more likely to be fatal than in younger alcoholics [2, 28].

Two groups can be distinguished among elderly patients with AUD. The first of them, accounting for approximately two thirds of geriatric patients with alcohol problems, are people who have been abusing alcohol since a young age. The diagnosis of addiction in these patients is generally easier due to the presence of multiple health problems resulting from long-term alcohol consumption. Patients from this group often have low socio-economic status, difficult family relationships, early job loss and conflicts with the law (Table 1). Difficulties in treating these patients often result from their refusal to admit that they have an addiction. The second group, which comprises approximately one third of elderly alcohol-abusing patients, includes those whose alcohol-related disorders started after the age of 65. The key role in this case is played by psychogenic and environmental factors, such as retirement, the loss of a spouse or receiving a diagnosis of a chronic illness. Health problems caused by the toxic effects of alcohol on the body are less severe than in patients with a long history of alcoholism, and therefore are often confused with the natural aging process. An uncharacteristic clinical picture, and the coexistence of depression, anxiety disorders and cognitive impairment, connected with a sense of shame and difficulty in admitting addiction, make the diagnosis more difficult in this group of patients (Table 1) [2, 28, 29].

There is a misconception among doctors that alcoholism is the domain of young and middle-aged people, and many specialists feel embarrassed to ask an elderly person about alcohol abuse. Consequently, most addicted patients are not diagnosed [25]. Meanwhile, the early detection of AUD enables the rapid introduction of appropriate treatment, thereby increasing its effectiveness and minimizing the damage to the body caused by long-term

alcohol abuse. Accordingly, it is important to know short screening tests for identifying alcohol use disorders. The Alcohol Use Disorder Identification Test (AUDIT), recommended by the World Health Organization, is a 10-question questionnaire which, depending on the number of points obtained, indicates low-risk drinking, hazardous drinking, harmful drinking and alcohol addiction [30]. The CAGE test consists of 4 short questions, where giving at least 2 affirmative answers implies serious alcohol problems [27]. However, the above tests are not specific to elderly patients, therefore the MAST-G (Michigan Alcohol Screening Test – Geriatric Version) test and its shorter version SMAST-G, which are characterized by high sensitivity and specificity in detecting alcohol problems in patients over 65 years of age, are recommended for elderly people [30, 31].

Treatment of AUD in elderly patients should be multidirectional, including not only pharmacological treatment, but also family support and participation in individual and group therapy. A 2018 study found that psychosocial treatment outcomes for alcoholism are better in patients over the age of 60 compared to those aged 40 to 59. It has been shown that the percentage of patients who achieved abstinence after 6-month therapy was 47.1% among older alcoholics and 35.4% among middle-aged alcoholics ($p<0.01$) [32]. In the case of acute withdrawal symptoms in the elderly, short-acting benzodiazepines are used. It is not recommended to use long-acting benzodiazepines in this group of patients, because the decreased hepatic clearance at this age hinders the elimination of the drug from the body [25, 31]. Chronic treatment of alcoholism in elderly patients should follow the "start low, go slow" principle, and be closely monitored for side effects, such as hypotension or cognitive impairment [31]. A well-tolerated drug in patients over 65 years of age is naltrexone, which is an opioid antagonist. However, its use is contraindicated in the simultaneous use of opioid drugs by the patient, as well as in the case of coexisting liver failure. Acamprosate is also a relatively safe drug, which supports glutaminergic transmission in the brain. It is especially recommended for patients who want to maintain abstinence. Disulfiram, which is an inhibitor of aldehyde dehydrogenase, is less frequently used in the elderly due to its numerous side effects and interactions with other drugs [25, 27, 28, 31].

Gambling addiction

Gambling, which is more and more common among the elderly population, is classified as addictive according to the ICD-11 classification [33]. Gambling can be defined as "the placing of a wager or bet of money or something of value on the outcome of an uncertain event that may include elements of skill and chance" [34].

It is recognized by the general public as a popular and legal form of entertainment and attracts with a variety of forms. Among the elderly, casinos, gaming machines, bingo, card games, lotteries, betting, Mahjong and now also online games are the most popular depending on the individual's origin and culture [35].

According to population studies, in groups over 65, the frequency of gambling is lower than in younger age groups. Addiction affects men more often than women in the general population, although it is worth noting that women are more likely to start gambling only in old age [35]. The prevalence of problem or pathological gambling in people over 60 years of age is estimated to range from 0.01% to 10.6%. This large discrepancy results from the different methodology of the conducted research (group recruitment, identification of the disorder, ethnic origin of the studied groups, research limitations) [34, 35].

Gambling in older people tends to develop on a different psychological basis than in younger people. Older people face difficulties characteristic of this period of life – they are often lonely people, struggling with many health problems, retired, with financial problems, and suffering from cognitive impairment. Therefore, unlike younger people, more often focused on winning and risking, the elderly are attracted even more by the social aspect of participating in a community, the way of spending free time and providing entertainment, coping with stress and negative emotions in this way, a false sense of control, although this aspect of life, especially when gambling is part of family or cultural traditions [36]. The very location of these games can be extremely attractive to them – they are attracted by a friendly atmosphere, a lack of judgment and new friendships [37].

Understanding the causes of compulsive gambling is an important aspect of helping someone combat harmful behavior. It is worth knowing what the risk factors are, because in the elderly there is a tendency to underestimate this problem, not asking for help, and at this time the addiction leads to serious consequences [36].

Today, gambling addiction is seen as a significant public health problem. It affects not only the life of the patient, but also his or her family, relatives and society. Gambling can lead to financial and housing problems fairly quickly, but addiction has consequences that extend far beyond the material realm [37]. This addiction has a negative impact on relationships with relatives, it increases stress and the long-term predominance of the sympathetic system, which, along with associated conditions, may reduce the body's resistance and lead to chronic diseases, and it is characterized by higher mortality and suicide rates (Table 1) [34, 35, 38]. On the other hand, there are reports of positive effects of gambling when it is only a form of pure fun. Such activity may improve self-esteem, cognitive functions such as memory, coordination, problem thinking and constitute a form of social life [35].

Addiction to gambling very often coexists with other mental disorders such as mood disorders, schizophrenia, phobias, neurotic and personality disorders, post-traumatic stress disorders, and also with organic diseases (resulting from, for example, stroke, dementia and serious brain injuries) [36, 39, 40, 41].

Moreover, the abuse of psychoactive substances, such as alcohol and drugs, is common among addicts [39, 40]. However, it is difficult to say unequivocally whether mental health problems are the cause or consequence of gambling addiction, or are caused by a common pathomechanism involving neurotransmitters and hormones, especially dopamine and the reward system [9, 37, 40]. There are studies showing an association between gambling addiction and the use of dopaminergic drugs such as levodopa, pramipexole, ropinirole, piribedil (used especially in patients with Parkinson's disease) and antipsychotics such as aripiprazole [9, 42].

It is worth noting that addiction to gambling does not have objective physical symptoms such as alcohol addiction. For this reason, the identification of patients is not so obvious. The importance of primary care physicians

in preventing serious gambling problems is emphasized [37]. Several screening tests based on the criteria of the disorder diagnosis have been proposed, such as the South Oak Gambling Screen (SOGS), the Diagnostic Interview for Gambling Severity (DIGS), the Lie / Bet Questionnaire, and the Early Intervention Gambling Health Test (EIGHT) [39].

Treatment of this addiction includes non-pharmacological treatment such as psychological therapy with behavioral, cognitive and behavioral-cognitive approaches, support through so-called Gamblers Anonymous, learning to play in a controlled way, brief interventions, the provision of advice and information and pharmacological treatment (selective serotonin reuptake inhibitors, opioid receptor antagonists, mood stabilizers are used) [39]. It is also important to treat coexisting mental disorders and other addictions simultaneously; however, this undoubtedly becomes more difficult and demanding and the prognosis is worse [40].

Cigarettes

Nicotine is one of the most psychoactive substances used internationally. It can be delivered in a variety of forms such as cigarettes, e-cigarettes, nicotine replacement therapy products and water pipes. Cigarettes are still the most popular product containing this substance. Nevertheless, heat-not-burn systems and e-cigarettes are gaining popularity [43].

Tobacco overuse is another problem leading to increased mortality rate and decreased life expectancy. It is assessed that more than 70 out of 7000 chemical compounds found in cigarette smoke may be carcinogens [44]. The problem of smoking is wrongly considered as a complication affecting mainly the young population. In European countries, the prevalence of cigarette use in the group of older adults (aged 65–74) is 8.4% and 12.2% for women and men respectively [45]. Data from the United States shows that cigarette use is less frequent in the population aged 65 and older in comparison to the younger group (aged 45–64), 9.3% and 22.6% respectively [46].

According to the Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition), tobacco use disorders, known as nicotine use disorders,

include criteria such as uncontrolled substance use, adverse effects on social functioning and daily activities, withdrawal symptoms and substance use despite knowledge of its harmfulness. Two out of eleven criteria should be observed within a 12-month period to diagnose the disorder [45]. To evaluate the level of nicotine dependence, the Fagerstrom Test is commonly used. It includes six questions related to smoking habits [47].

Tobacco use disorder occurs more frequently in the population characterized by alcohol use disorder, low socioeconomic status, life stressors and psychiatric components such as depression or anxiety [45]. As many previous studies, research by Quittschalle et al. proved that frequency of smoking is associated with severity of depression in the elderly population. However, the exact explanation of whether cigarette use causes depression or depression makes nicotine dependence worse is not known [48].

Due to the cumulative effect of tobacco use, the elderly population is at higher risk of experiencing health consequences. Smoking increases the risk of cardiovascular diseases, peripheral artery diseases, uncontrolled asthma, sinusitis and osteoporosis. It is known that smoking is a risk factor for lung, bladder, kidney, head and neck cancer development. Getting older naturally affects lung function and tobacco use accelerates the destruction process. Furthermore, community-acquired pneumonia occurs more likely in elderly smokers (Table 1) [45].

A significant consequence of smoking in elderly patients may be cognitive impairment (Table 1). Tobacco use is associated with a higher prevalence of vascular dementia or Alzheimer disease.

As is commonly known, the elderly population struggle with sleep disorders more often than the younger population (Table 1) [49]. Some studies showed that tobacco smoking influences sleep. In the Saif Aldeen AlRyalat et al. randomized controlled study, an association between nicotine dose and sleeping problems is shown. The higher the daily nicotine dose, the more sleep interruption is observed [50]. It is important to consider smoking as a risk factor of insomnia and sleeping troubles in older patients.

Smoking cessation is more challenging in elderly patients. This group may have less knowledge about cigarette misuse harm and its health

consequences. Additionally, nicotine use disorder affects those patients for a longer time [45, 51]. As mentioned in the research of Doaa Abdel-Hady and Abdel-Hady El-Gilany, most studies have shown decreasing nicotine use while aging. However, their study proved no significant difference in the rate of giving up smoking among the younger and older population.

The decision to stop smoking cigarettes among those who are 60 or older is influenced by many factors. Successful tobacco cessation happens more likely in patients who have been smoking for a shorter period of time, a smaller daily dose of nicotine, lack of alcohol abuse, and those with social support. Taking more medication due to comorbidities also contributes to effective smoking cessation.

Unlike previous studies that identified normal cognitive function as a factor increasing cigarette cessation, in the Jiska Cohen-Mansfield study it was proven that cognitive dysfunction facilitates successful non-smoking. These contrasting results may be due to differences in average age among the compared study groups and inconsistency in cognitive function diagnosis [46]. Further research is needed to clarify the association between cognitive impairment and successful tobacco cessation.

Table 1. Characteristic symptoms of abuse depending on the type of addiction

Type of addiction	Characteristic symptoms
Drugs	• impairment of physical and cognitive functions • increased risk of dementia • fractures and traffic accidents
Alcohol	• cognitive impairment • confusion • increased risk of depression • social functioning disorders
Gambling	• loss of family relationships • deceiving relatives about addiction • long-term stimulation of the sympathetic nervous system
Cigarettes	• sleep disorders • uncontrolled asthma • memory dysfunction • severe community-acquired pneumonia

Discussion

The issue of addiction among the elderly is a significant one for both users themselves and the general public. With an aging population and an increasing number of addicts in every age group, this could become difficult to address and an overwhelming problem in the near future. It is important to note that any type of addiction can lead to progressive health problems that, among the elderly, can create an increased need for care, including health care. Increased physical and mental morbidity can lead to increased use of medications, polypharmacy, and increasing dependence of an individual's functioning on medication. The inability to meet one's need for an addictive agent for a variety of reasons (e.g., financial, health, physical) can lead to attempts to substitute one addiction for another, ultimately never achieving recovery from addiction.

The results of our review of the literature clearly indicate an increased prevalence of drug addiction among the elderly compared to younger people. At the same time, we found rather disturbing findings in the research results showing that addictions among the elderly can often result from inattentive management of the geriatric patient by the physicians who treat them [2]. Inappropriate drug selection, drug combinations that lead to drug interference or that exacerbate drug side effects, can lead to self-modification of therapy, especially for sleeping pills or analgesics [35]. It is the responsibility of the physician to monitor the patient's proper medication intake. It is also the physician's responsibility to recognize signs of addiction in the patient. This is a particularly difficult task because for the most common addictive agents, such as alcohol, opioids, or sedatives and hypnotics, the signs of addiction in older adults are nonspecific. They may resemble typical changes that occur with age, including dementia, depression, anxiety disorders, cognitive impairment, or decreased independence [2, 21, 35].

Many studies of addiction in the elderly identify common predisposing factors such as loneliness, not feeling needed, and chronic illness [12]. Therefore, it can be suspected that the treatment of addiction among the elderly

will be different from that of younger people. Activating older adults professionally and socially will be important in treatment. In the case of chronic diseases that require multi-drug therapy, the most important thing will be the appropriate selection of medications and, above all, patient education.

Just as we indicated above, addiction often leads to complications that result in the use of more and more drugs. It is no different with nicotine addiction. Patients find it easier to quit only when their health situation forces them to do so, by which time the consequences of a long-standing addiction may already be irreversible. As noted in the Cohen-Mansfield study, people who quit smoking used more medication than those who continued to smoke. It can be assumed that a significant influence on quitting smoking here was the consequences of addiction, which will most often manifest themselves after the age of 50–60. Thus, there may be a difference in the prevalence of nicotine addiction among people over 65 and the younger group aged 45–64, where smoking is about 2.5 times more common [46].

Gambling addiction in older adults has a slightly different background than other addictions. Initially, gambling can have a positive effect on the elderly, giving them a sense of control over their lives, reducing feelings of loneliness by belonging to a certain community, and to some extent providing mental exercise that can delay the onset of dementia [35, 36]. At the same time, gambling is an additional stressor on the body that can significantly impair the health of older adults [35]. Is gambling then good or bad for older people? It is not easy to clearly delineate the point at which social gaming becomes a life-threatening addiction. Older adults are often unaware of the problem and so do not seek help [36].

As in any addiction, whether it is drugs, alcohol, cigarettes, or gambling, one of the most important people who can detect the addiction and act in advance is the patient's family physician. The reluctance to ask geriatric patients about stimulant use or gambling should not hinder this important task of preventing harmful addictions [2, 37].

Conclusions

Addictions in older adults are not the same as those in younger adults and should be considered separately. Older adults are particularly vulnerable to drug addiction. The physician has a significant role in recognizing and treating addiction in older patients, regardless of the type of addiction. More research is needed on the relationship of addiction to mental illness, such as the relationship of depression to nicotinism or the disruption of dopaminergic transmission in gambling addiction. Also important for further research is the question of the influence of cognitive dysfunction on the effectiveness of smoking cessation.

References

1. Szpringer M, Czerwiak G, Czerwiak A. Uzależnienia wieku podeszłego. Piel Pol 2013; 4(50): 324–328.

2. Habrat B. Problemy związane z piciem alkoholu przez osoby starsze. Postępy Nauk Med 2011; 8: 701–704.

3. NIDA. Substance use in older adults. Drug facts. National Institute on Drug Abuse; 2020.

4. Moryson W, Stawińska-Witoszyńska B. Premature mortality due to tobacco-related malignancies in Poland. Int J Gen Med 2021; 14: 2171–2182.

5. McFarlane O, Kędziora- Kornatowska K. Przyjmowanie leków w późnej dorosłości – potrzeba edukacji zdrowotnej. Rocznik Andrologiczny 2018; 24: 213.

6. Błeszyńska E, Wierucki Ł, Zdrojewski T, Renke M. Interakcje farmakologiczne u osób starszych. Medycyna (Kowno) 2020; 56(7): 320.

7. Schepis TS, Wastila L, Ammerman B, McCabe VV, McCabe SE. Prescription opioid misuse motives in US older adults. Pain Medicine 2020; 21(10): 2237–2243.

8. Brewster GS, Riegel B, Gehrman PR. Insomnia in the older adult. Sleep Med Clin 2018; 13(1): 13–19.

9. Wolfschlag M, Håkansson A. Increased risk for developing gambling disorder under the treatment with pramipexole, ropinirole, and aripiprazole: A nationwide register study in Sweden. PLoS One 2021; 16(6): 1–12.

10. Ramirez V, Wiers CE, Wang GJ, Volkow ND. Personality traits in substance use disorders and obesity when compared to healthy controls. Addiction 2020; 115: 2130–2139.

11. Koller G, Preuss U, Lü O, Soyka M, Pogarell O. Alcohol-dependent subjects show different personality traits compared with subjects with multiple substance dependence: preliminary data. J Addict Med 2015; 9(4): 257–260.

12. Elton-Marshall T, Wijesingha R, Sendzik T, Mock SE, van der Maas M, McCready J, Mann RE, Turner NE. Marital status and problem gambling among older adults: an examination of social context and social motivations. Can J Aging 2018; 37(3): 318–332.

13. Gray MT. Habits, rituals, and addiction: an inquiry into substance abuse in older persons. Nurs Philos 2014; 15(2): 138–151.

14. Dziedzic B, Idzik A, Kobos E, et al. Loneliness and mental health among the elderly in Poland during the COVID-19 pandemic. BMC Public Health 2021; 1976: 1–12.

15. Airagnes G, Pelissolo A, Lavallée M, Flament M, Limosin F. Benzodiazepine misuse in the elderly: risk factors, consequences, and management. Curr Psychiatry Rep 2016; 18(10): 89.

16. Lehmann SW, Fingerhood M. Substance-use disorders in later life. N Engl J Med 2018; 379(24): 2351–2360.

17. Hale D, Marshall K. Substance abuse in older adults. Home Healthc Now 2017; 35(10): 568–569.

18. Yarnell S, Li L, MacGrory B, Trevisan L, Kirwin P. Substance use disorders in later life: a review and synthesis of the literature of an emerging public health concern. Am J Geriatr Psychiatry 2020; 28(2): 226–236.

19. Chhatre S, Cook R, Mallik E, Jayadevappa R. Trends in substance use admissions among older adults. BMC Health Serv Res 2017; 17: 584.

20. Sobów T. Benzodiazepiny u pacjentów w wieku podeszłym. Psychiatria 2010; 7(6): 244–249.

21. Basińska A. Leczenie uzależnienia od benzodiazepin u osób w wieku podeszłym. Postępy Nauk Medycznych 2011; 24(8): 644–648.

22. Maree RD, Marcum ZA, Saghafi E, Weiner DK, Karp JF. A systematic review of opioid and benzodiazepine misuse in older adults. Am J Geriatr Psychiatry 2016; 24(11): 949–963.

23. Krajnik M, Sobański P. Leczenie farmakologiczne i radioterapia bólu nowotworowego u dorosłych i młodzieży. Omówienie wytycznych Światowej Organizacji Zdrowia 2018 w kontekście problemów ze stosowaniem opioidów. Medycyna Praktyczna 2019; 10: 75–87.

24. Sierosławski J, Oszacowanie liczby problemowych użytkowników opioidów w Polsce. Alkoholizm i Narkomania 2012; 25(4): 347–356.

25. Fagbemi M. How do you effectively evaluate the elderly for alcohol use disorder? Cleve Clin J Med 2021; 88(8): 434–439.

26. Bartoszek A, Kocka K, Zielonka E, et al. Problem stosowania używek wśród seniorów mieszkających w środowisku domowym. Journal of Education, Health and Sport 2016; 6(6): 235–244.

27. Fenollal-Maldonado G, Brown D, Hoffman H, Kahlon C, Grossberg G. Alcohol use disorder in older adults. Clin Geriatr Med 2022; 38(1): 1–22.

28. Gopalakrishna G, Patel N. Do not drink, do not drive: alcohol use disorder in the elderly. Prim Care Companion CNS Disord 2021; 23(5): 21.

29. Szafranek A. Problem nadużywania alkoholu przez osoby starsze zamieszkujące domy pomocy społecznej – aspekty prawno-społeczne i wyzwania dla edukacji. Pedagogika Społeczna 2018; 3(69): 203–219.

30. Puto G, Targosz B, Repka I, Ścisło L, Musiał Z. Rozpoznawanie uzależnień od alkoholu i tytoniu wśród osób starszych. Problemy Pielęgniarstwa 2015; 23(3): 344–348.

31. Lal R, Pattanayak RD. Alcohol use among the elderly: Issues and considerations. J Geriatr Ment Health 2017; 4: 4–10.

32. Wieben ES, Nielsen B, Nielsen AS, Andersen K. Elderly alcoholics compared to middle-aged alcoholics in outpatient treatment – 6-month follow-up. Nord J Psychiatry 2018; 72(7): 506–511.

33. Gaebel W, Zielasek, J, Reed GM. Zaburzenia psychiczne i behawioralne w ICD-11: koncepcje, metodologie oraz obecny status. Psychiatria Polska 2017; 51(2): 169–195.

34. Subramaniam M, Wang P, Soh P, et al. Prevalence and determinants of gambling disorder among older adults: a systematic review. Addict Behav 2015; 41: 199–209.

35. Tse S, Hong SI, Wang CW, Cunningham-Williams RM. Gambling behavior and problems among older adults: a systematic review of empirical studies. J Gerontol B Psychol Sci Soc Sci 2012; 67(5): 639–652.

36. Tirachaimongkol LC, Jackson AC, Tomnay JE. Pathways to problem gambling in seniors. J Gerontol Soc Work 2010; 53(6): 531–546.

37. Bramley S, Norrie C, Manthorpe J. The nature of gambling-related harm for adults with health and social care needs: an exploratory study of the views of key informants. Prim Health Care Res Dev 2019; 20: 1–7.

38. Karlsson A, Håkansson A. Gambling disorder, increased mortality, suicidality, and associated comorbidity: A longitudinal nationwide register study. J Behav Addict 2018; 7(4): 1091–1099.

39. Wieczorek Ł, Dąbrowska K. Zaburzenia hazardowe–rozpowszechnienie, oferta terapeutyczna, dostępność leczenia i predyktory podjęcia leczenia. Przegląd literatury. Alcoholism and Drug Addiction 2015; 28(1): 37–54.

40. Dąbrowska K, Wieczorek Ł. Problem współwystępowania zaburzeń hazardowych z zaburzeniami psychicznymi. Przegląd literatury. Alcoholism and Drug Addiction 2016; 29(1): 17–26.

41. Turner NE, Cook S, Shi J, et al. Traumatic brain injuries and problem gambling in youth: Evidence from a population-based study of secondary students in Ontario, Canada. PLoS One 2020; 15(10): 1–12.

42. Wang Y, Lu Z, Xun G. Pathological gambling in a patient on piribedil: A case report. Medicine (Baltimore) 2021; 100(6): 1–4.

43. Ziedonis D, Das S, Larkin C. Tobacco use disorder and treatment: new challenges and opportunities. Dialogues Clin Neurosci 2017; 19(3): 271–280.

44. Krawczyk P, Ramlau R, Błach J, et al. Risk factors and primary prevention of lung cancer. Cessation of cigarette addiction. Oncology in Clinical Practice 2021; 17(3): 112–124.

45. Bassil NK, Ohanian MLK, Bou Saba TG. Nicotine use disorder in older adults. Clin Geriatr Med 2022; 38(1): 119–131.

46. Cohen-Mansfield J. Predictors of smoking cessation in old-old age. Nicotine Tob Res 2016; 18(7): 1675–1679.

47. de Granda-Orive JI, Pascual-Lledó JF, Asensio-Sánchez S, et al. Fagerström test and heaviness smoking index. Are they interchangeable as a dependence test for nicotine? Subst Use Misuse 2020; 55(2): 200–208.

48. Quittschalle J, Pabst A, Löbner M, et al. Association of alcohol and tobacco consumption with depression severity in the oldest old. Results from the age different old age cohort platform. Int J Environ Res Public Health 2021; 18(15): 1–14.

49. Gulia KK, Kumar VM. Sleep disorders in the elderly: a growing challenge. Psychogeriatrics 2018; 18(3): 155–165.

50. AlRyalat SA, Kussad S, El Khatib O, et al. Assessing the effect of nicotine dose in cigarette smoking on sleep quality. Sleep Breath 2021; 25(3): 1319–1324.

51. Abdel-Hady D, El-Gilany AH. Tobacco use and its associated factors among older people: a community-based study in Egypt. East Mediterr Health J 2020; 26(1): 68–74.

Journal of Health Study and Medicine
2022, No. 2
pp. 69–83
DOI 10.36145/JHSM2022.11

The Use and Efficacy of the Low FODMAP Diet in the Treatment of Gastrointestinal Diseases

Submitted: 17 April 2022 Accepted: 21 September 2022 Published: 30 December 2022

Karolina Mikut[1]
https://orcid.org/0000-0001-7022-581X

Aleksandra Wijata[1]
https://orcid.org/0000-0001-6263-1826

Joanna Osiak[1]
https://orcid.org/0000-0002-6310-9981

Kornelia Kędziora-Kornatowska[1]
https://orcid.org/0000-0003-4777-5252

1 Department and Clinic of Geriatrics, Collegium Medicum of Nicolaus Copernicus University in Torun, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Poland

Address for correspondence

Karolina Mikut
Ludwik Rydygier Collegium Medicum in Bydgoszcz
Nicolaus Copernicus University in Torun
13–15 Jagiellońska St.
85-067 Bydgoszcz, Poland
karolina.mikut@gmail.com

Abstract

Introduction and objective: *The L-FODMAP diet limits products that contain hard-to-digest carbohydrates and other substances that may affect the symptoms of gastrointestinal diseases. The main objective is to eat foods with a low content of poorly absorbable carbohydrates that undergo fermentation and lead to an increase in osmotic pressure in the small and large intestine. This group includes lactose, fructose, polyhydroxy alcohols (mannitol, xylitol, sorbitol), galactooligosaccharides and fructans. The aim of this work is to review the available studies and to collect information on the use of the L-FODMAP diet in gastroenterological diseases.*

Abbreviated description of the state of knowledge: *Research results show that there are benefits of using the L-FODMAP diet in patients with irritable bowel syndrome – in the group of patients on a L-FODMAP diet there was a significant improvement in gastrointestinal symptoms as well as an improvement in quality of life. In the remission of inflammatory bowel diseases such as colitis ulcerosa and Crohn's disease, a reduction of symptoms and an improvement in quality of life were also observed, a reduction of symptoms and an improvement in quality of life were also observed. There have been studies on the use of this diet in gastroesophageal reflux disease, but no hard evidence of its effectiveness has been found yet.*

Summary: *According to the results of recent studies, we can assume that the L-FODMAP diet can reduce troublesome ailments in some gastroenterological diseases. It is also important to remember that its use can lead to the elimination of many nutrients. There may also be a negative impact on motility and intestinal microbiota. More clinical trials are needed to provide more evidence for the use of the L-FODMAP diet in these disease entities.*

Key words: *diet, irritable bowel syndrome, crohn's disease, ulcerative colitis, gerd*

Introduction

In recent years, there has been growing interest in a diet low in fermenting oligosaccharides, disaccharides, monosaccharides, and polyols (L-FODMAP). It is mainly used in the treatment of functional symptoms in irritable bowel syndrome (IBS), but it is also used in an increasing number of patients who are suffering from other conditions. The main assumptions of the L-FODMAP diet are to eat foods with a low content of poorly absorbable carbohydrates that undergo fermentation and increase osmotic pressure in the small and large intestines. This group includes lactose, fructose, polyhydroxy alcohols (mannitol, xylitol, sorbitol), galactooligosaccharides, and fructans. The above-mentioned compounds are common in an average diet; they are found in vegetables, fruits, legumes, dairy products, grain products, oilseeds, spices, sugar products, alcoholic beverages, sweeteners, and many processed products [1, 2].

There are two basic mechanisms leading to the appearance or worsening of symptoms as a result of consuming the compounds contained in the FODMAP. In the first of them, as a result of the high osmotic activity of FODMAP, there is an increased secretion of fluids into the intestinal lumen and the subsequent stretching of its walls, which leads to symptoms. The second mechanism leading to the development of symptoms is the rapid fermentation of FODMAP by the gut bacteria, which results in an overproduction of gas in the gut lumen. The result of gas accumulation is pain, discomfort, and flatulence [2, 3].

The L-FODMAP diet is not a diet that should be used for life. It consists of three stages. In the first phase of the diet, products containing large amounts of FODMAP (milk, cottage cheese, honey, onions, wheat products, sweetener, glucose-fructose syrup, etc.) should be excluded for a period of 6 to 8 weeks and replaced with products containing low FODMAP content. After this time, as symptoms subside, the transition to stage two occurs, in which the diet is gradually expanded to include products containing more FODMAPs. The third step is the individualization of the diet with the elimination of foods that cause symptoms [4, 5].

Table 1. Examples of products with low and high FODMAP content [7]

Food group	Low FODMAP	High FODMAP
Dairy	cheddar cheese, brie cheese, camembert cheese, almond milk, rice milk, butter, peanut butter, margarine	cottage cheese, mascarpone cheese, ricotta cheese, yogurt, cow's milk, cream, soy milk
Grains	quinoa, rice, millet, cornmeal, gluten-free products	wheat, barley, rye
Proteins	meat, fish, poultry, eggs, tofu	lentils, chickpeas, beans, soy
Fruits	bananas, grapes, kiwi, mandarins, oranges	apple, pear, mango, watermelon, peaches, apricots
Vegetables	carrots, tomatoes, cucumbers, peppers, celery, corn, eggplant, lettuce, pumpkin, zucchini, sweet potatoes, chives	onions, asparagus, artichokes, broccoli, cauliflower, brussels, green peas, leeks, red beet, cabbage, fennel, garlic
Other	granulated sugar, maple syrup, aspartame, stevia, espresso, filtered coffee, green tea	agave syrup, honey, glucose-fructose syrup, sweeteners (sorbitol, mannitol, maltitol, xylitol), fruit juices, instant coffee

Apart from the use of the L-FODMAP diet in the treatment of symptoms of irritable bowel syndrome, studies have also been undertaken to evaluate the use of the L-FODMAP diet in the course of other gastrointestinal diseases – Crohn's disease, ulcerative colitis, and others [6]. This work aims to review the available studies and collect information on the use of the low FODMAP diet in the following disease entities.

Irritable bowel syndrome (IBS)

Irritable bowel syndrome is a chronic, functional gastrointestinal disease characterized by recurrent gas, altered bowel movements, and abdominal pain without an underlying organic or biochemical cause. The cause of the disease is probably complex and has not been fully understood. Many factors are involved in the pathogenesis of IBS, and the most important role is attributed to disturbances in gut-brain interaction. Other factors include disorders of the intestinal microbiota, food intolerances, a history of infectious diarrhea, intestinal motility disorders, visceral hypersensitivity as well as genetic and psychosocial factors, especially chronic stress of considerable intensity.

The diagnosis of IBS is based on the Rome IV criteria, which state that if during the last three months, for at least one day a week, there was abdominal pain related to bowel movement, change in its consistency, or change in the bowel movement rhythm (2 criteria must be met), IBS can be diagnosed. According to the IV Rome criteria, several forms of IBS may be distinguished based on the dominant symptoms. We can identify IBS with diarrhea (IBS-D), IBS with constipation (IBS-C), mixed IBS (IBS-M), and the unclassified form (IBS-U) [8].

So far, no clear cause of IBS has been established, so there is no possibility of using causal therapy. Irritable bowel syndrome is a chronic disease, with most patients having recurring symptoms, sometimes for life. An important step in the treatment is a lifestyle change, especially increasing physical activity and modifying the diet. In 2006, one of the first retrospective studies on the effect of FODMAP on the incidence of disease symptoms in the group of patients with irritable bowel syndrome with fructose malabsorption was published. Following the commencement of the L-FODMAP diet, improvement was observed in 74% of patients in the study group [5].

A study by Zahedi et al. shows that in patients with IBS-D who began to follow the L-FODMAP diet, after 6 weeks there was a significant improvement in gastrointestinal symptoms compared to the GDA (general dietary advice) group [9].

A study by Halmos et al., including 30 IBS patients and 8 healthy patients who followed either the L-FODMAP diet or the classic diet for 21 days, proved that a diet low in FODMAP was effective in reducing gastrointestinal functional symptoms in IBS patients [10].

Meta-analysis using 9 randomized controlled trials (RCT), including a total of 596 subjects (3 RCTs compared the L-FODMAP diet with a habitual diet, 2 RCTs provided all meals and compared the L-FODMAP diet with a western diet, 1 RCT compared the L-FODMAP diet with a diet high in FODMAPs or a sham diet, and 2 RCTs compared the L-FODMAP diet with other diet recommendations for IBS) showed significant group differences for the L-FODMAP diet for gastrointestinal symptoms, abdominal pain, and health-related quality of life compared with other diets. This meta-analysis found evidence of the short-term efficacy and safety of the L-FODMAP diet in patients with IBS [11].

Small intestinal bacterial overgrowth (SIBO)

Small intestinal bacterial overgrowth syndrome (SIBO) is a diverse disease that is often underdiagnosed due to non-specific symptoms, such as abdominal discomfort, constipation, flatulence, diarrhea, and abdominal pain [12]. The most common risk factors for excessive bacterial overgrowth in the small intestine include anatomical abnormalities and disturbances in the motility of the small intestine [13]. The most common non-invasive diagnostic method is the methane and hydrogen breath test, while the microbial investigation of jejunal aspirates is still the gold diagnostic standard [12]. Treatment of SIBO is based mainly on antibiotics, but supportive drugs, such as probiotics or PPIs (proton pump inhibitors), are also used [14].

An adequate diet should be the complementary treatment to antibiotic therapy used in SIBO. In patients with SIBO, carbohydrates such as monosaccharides, disaccharides, oligosaccharides, lactose, and fructose are fermented by intestinal bacteria, leading to the formation of excessive gas, which is manifested by abdominal pain and flatulence [15]. The L-FODMAP diet is recommended to reduce symptoms and prevent the recurrence of SIBO. However, studies on the effectiveness of the L-FODMAP diet in SIBO therapy are based on studies of patients with IBS, which clinically overlap with SIBO to a large extent [16]. The L-FODMAP diet reduces the population of selected bacteria due to the limitation of the consumption of substances necessary for their proliferation and growth [15]. Studies assessing the effect of the L-FODMAP diet on SIBO showed a decrease in Bifidobacteria in stool samples collected from patients, and a decrease in the concentration of exhaled hydrogen compared to the group not using the L-FODMAP diet. However, no differences were found in the case of colonic volume between the group using the L-FODMAP diet and the group not using the diet [17].

Crohn's disease

Crohn's disease (CD) is classified as a chronic inflammatory disease of the gastrointestinal tract of a granulomatous nature. Inflammation most commonly

affects the terminal ileum, ileo-colon, colon, and anus, but can affect any part of the digestive tract from the mouth to the anus. The most common symptoms include abdominal pain, diarrhea, mucus or blood in the stool, weight loss, irritation, and discharge from perianal fistulas. Uveitis, arthritis, and skin rash are among the extraintestinal symptoms of Crohn's disease. The diagnosis takes into account the clinical picture as well as endoscopic, radiological, histological, and biochemical examinations [18].

Research shows that the introduction of an appropriate diet in CD can positively affect the reporting of symptoms, disease progression, inflammatory markers, and the patient's quality of life [19]. Many studies show the benefits of the Mediterranean diet and the L-FODMAP diet [20, 21, 22, 23]. Patients following the L-FODMAP diet should limit products that are a source of fermentable oligosaccharides, disaccharides, monosaccharides, and polyols, which are poorly absorbed in the intestine and are strongly fermented by intestinal bacteria, which causes flatulence, abdominal pain, and diarrhea [24, 25]. In the studies on the effectiveness of the L-FODMAP diet in patients with CD, it was found to reduce inflammatory markers, reduce the number of diarrheal stools, alleviate gastrointestinal symptoms, and improve the quality of life [26, 27, 28, 29]. Despite the strong evidence of reducing gastrointestinal discomfort in patients with CD, we must be aware that this diet can lead to potential side effects. A restrictive diet can lead to a deterioration in nutritional status; therefore, a dietitian should ensure an adequate supply of fiber and calcium energy is provided. Studies were carried out to assess the fecal microbiota of healthy people and people with CD who were on the L-FODMAP diet, and healthy people and people with CD who were not using this diet. The prebiotic effect of FODMAP-containing products has been demonstrated compared to patients on a diet that restricts these products [28]. Although the effectiveness of the L-FODMAP diet has been demonstrated in many studies, the restrictiveness and difficulties in using the L-FODMAP diet require the support of a dietitian. Difficulties in maintaining a diet and excluding multiple products are a source of heterogeneity in the overall results, which is the main limitation of these studies [30].

Ulcerative colitis

Colitis ulcerosa (UC), like Crohn's disease, belongs to the group of inflammatory bowel diseases (IBD). Unlike Crohn's disease, it is confined to the rectum and large intestine, affects the superficial layers of the gut wall, and most commonly presents with diarrhea, with up to 20 bowel movements a day, usually with blood. It is a chronic disease and at the moment incurable, so it is important to look for activities that, apart from pharmacotherapy, could improve the quality of life. Unfortunately, most studies examining the effects of FODMAP on inflammatory bowel disease recruit people with both Crohn's disease and UC – there are no studies based on each of these diseases separately. One study showed that a L-FODMAP diet reduced fecal microbes believed to regulate the immune response, but the diet did not affect inflammatory markers [31]. Studies have also shown the elimination of intestinal symptoms (such as flatulence) in patients in remission and with IBS symptoms [32]. The respondents also assessed their quality of life as better. [31] A randomized, double-blind study was also conducted in which quiescent IBD and functional gastrointestinal symptoms patients responding to a L-FODMAP diet were assigned to a series of 3-day challenges with several fermenting carbohydrates in random order. The fructans used in the study exacerbated functional gastrointestinal symptoms in quiescent IBD [33]. A systematic review conducted on studies collected from three medical databases revealed that the L-FODMAP diet shows promising therapeutic benefits for IBD patients [6]. In both Crohn's disease and UC, the L-FODMAP diet may be considered as a possible treatment. However, it is important to consider possible side effects and weigh the pros and cons.

Gastroesophageal Reflux Disease (GERD)

There have been reports of attempted treatment of GERD patients with the L-FODMAP diet. There is not much research on this topic and the results are conflicting. One Norwegian study of 12 people showed a reduction in both symptomatic and asymptomatic reflux episodes on the L-FODMAP diet

compared to the normal diet [34]. Another study in 31 subjects showed that the L-FODMAP diet and usual dietary recommendations had a similar but limited beneficial effect to proton pump inhibitors treatment on symptoms in patients with refractory GERD [35]. However, in patients with overlapping IBS, this diet may alleviate the postprandial symptoms of GERD [36]. Due to the lack of conclusive evidence, the lack of high-efficacy studies, and a larger research group, this diet has not found widespread use in the treatment of GERD.

Summary

The L-FODMAP diet is gaining popularity mainly among patients with irritable bowel syndrome, but there are also reports of its positive effects on other gastrointestinal conditions such as Crohn's disease, ulcerative colitis, and SIBO. However, although the L-FODMAP diet can reduce the troublesome ailments of irritable bowel syndrome, inflammatory bowel diseases, and other gastrointestinal diseases, its use leads to the elimination of many nutrients, such as vegetables, fruits, dairy products, and cereals, which may result in a deficiency of B vitamins, calcium, iron, and other valuable substances. [1, 37, 38] Therefore, supplementation could be necessary, especially iron. Regular checkups and consultations with a specialist supervising the course of treatment are essential. In addition to nutrient deficiencies, there may also be a negative impact on motility and the intestinal microbiota, which is why a long-term diet (over 6–8 weeks) is not recommended [1, 2, 39]. Due to the individual tolerance threshold for products with high FODMAP content, it is also recommended to personalize the diet. In conclusion, it is necessary to conduct more clinical trials that will provide more evidence for the use of the L-FODMAP diet in these diseases.

References

1. Bellini M, Tonarelli S, Nagy AG, Pancetti A, Costa F, Ricchiuti A, Bortoli N, Mosca M, Marchi S, Rossi A. Low FODMAP Diet: Evidence, Doubts, and Hopes. Nutrients 2020 Jan; 12(1): 148.

2. Gibson PR, Shepherd SJ. Evidence-based dietary management of functional gastrointestinal symptoms: The FODMAP approach. J Gastroenterol Hepatol 2010 Feb; 25(2): 252–258.

3. Mansueto P, Seidita A, D'Alcamo A, Carroccio A. Role of FODMAPs in Patients with Irritable Bowel Syndrome. Nutr Clin Pract 2015 Oct; 30(5): 665–682.

4. Zanetti AJA, Rogero MM, von Atzingen MCBC. Low-FODMAP diet in the management of irritable bowel syndrome. Nutrire 2018; 43: 17.

5. Shepherd SJ, Gibson PR. Fructose malabsorption and symptoms of irritable bowel syndrome: guidelines for effective dietary management. J Am Diet Assoc 2006 Oct; 106(10): 1631–1639.

6. Charlebois A, Rosenfeld G, Bressler B. The Impact of Dietary Interventions on the Symptoms of Inflammatory Bowel Disease: A Systematic Review. Crit Rev Food Sci Nutr 2016 Jun 10; 56(8): 1370–1378.

7. University of Virginia, UVA Nutrition [Internet]. Available from: https://med.virginia.edu/ginutrition/wp-content/uploads/sites/199/2018/05/Low_FODMAP_Diet_12.16.pdf [cited 23 March 2022].

8. Drossman DA. Functional Gastrointestinal Disorders: History, Pathophysiology, Clinical Features, and Rome IV. Gastroenterology 2016 Feb 19; S0016-5085(16)00223-7.

9. Zahedi MJ, Behrouz V, Azimi M. Low fermentable oligo-di-mono-saccharides and polyols diet versus general dietary advice in patients with diarrhea-predominant irritable bowel syndrome: A randomized controlled trial. J Gastroenterol Hepatol 2018 Jun; 33(6): 1192–1199.

10. Halmos EP, Power VA, Shepherd SJ, Gibson PR, Muir JG. A diet low in FODMAPs reduces symptoms of irritable bowel syndrome. Gastroenterology 2014 Jan; 146(1): 67–75.e5.

11. Schumann D, Klose P, Lauche R, Dobos G, Langhorst J, Cramer H. Low fermentable, oligo-, di-, mono-saccharides and polyol diet in the treatment of irritable bowel syndrome: A systematic review and meta-analysis. Nutrition 2018 Jan; 45: 24–31.

12. Bures J, Cyrany J, Kohoutova D, et al. Small intestinal bacterial overgrowth syndrome. World J Gastroenterol 2010; 16(24): 2978–2990.

13. Jacobs C, Coss Adame E, Attaluri A, Valestin J, Rao SS. Dysmotility and proton pump inhibitor use are independent risk factors for small intestinal bacterial and/or fungal overgrowth. Aliment Pharmacol Ther 2013 Jun; 37(11): 1103–1111.

14. Rao SSC, Bhagatwala J. Small Intestinal Bacterial Overgrowth: Clinical Features and Therapeutic Management. Clin Transl Gastroenterol 2019 Oct; 10(10): e00078.

15. Achufusi TGO, Sharma A, Zamora EA, Manocha D. Small Intestinal Bacterial Overgrowth: Comprehensive Review of Diagnosis, Prevention, and Treatment Methods. Cureus 2020 Jun 27; 12(6): e8860.

16. Borghini R, Donato G, Alvaro D, Picarelli A. New insights in IBS-like disorders: Pandora's box has been opened; a review. Gastroenterol Hepatol Bed Bench 2017 Spring; 10(2): 79–89. PMID: 28702130; PMCID: PMC5495893.

17. Guilliams TG, Drake LE. Small Intestinal Bacterial Overgrowth (SIBO): Diagnostic Challenges and Functional Solutions; 2021.

18. Mills SC, von Roon AC, Tekkis PP, Orchard TR. Crohn's disease. BMJ Clin Evid 2011; 0416. Published 2011 Apr 27.

19. Chiba M, Abe T, Tsuda H, Sugawara T, Tsuda S, Tozawa H, Fujiwara K, Imai H. Lifestyle-related disease in Crohn's disease: Relapse prevention by a semi-vegetarian diet. World J Gastroenterol 2010; 16: 2484–2495.

20. Truswell AS, Seach JM, Thorburn AW. Incomplete absorption of pure fructose in healthy subjects and the facilitating effect of glucose. Am J Clin Nutr 1988; 48: 1424–1430.

21. Parker K, Salas M, Nwosu VC. High fructose corn syrup: Production, uses and public health concerns. Biotechnol Mol Biol Rev 2010; 5: 71–78.

22. Rumessen JJ, Gudmand-Høyer E. Absorption capacity of fructose in healthy adults. Comparison with sucrose and its constituent monosaccharides. Gut 1986; 27: 1161–1168.

23. van den Bogert B, de Vos WM, Zoetendal EG, Kleerebezem M. Microarray analysis and barcoded pyrosequencing provide consistent microbial profiles depending on the source of human intestinal samples. Appl Environ Microbiol 2011; 77: 2071–2080.

24. Prince AC, Myers CE, Joyce T, Irving P, Lomer M, Whelan K. Fermentable Carbohydrate Restriction (Low FODMAP Diet) in Clinical Practice Improves Functional Gastrointestinal Symptoms in Patients with Inflammatory Bowel Disease. Inflamm. Bowel Dis 2016; 22: 1129–1136.

25. Kakodkar S, Farooqui, AJ, Mikolaitis SL, Mutlu EA. The Specific Carbohydrate Diet for Inflammatory Bowel Disease: A Case Series. J Acad Nutr Diet 2015; 115: 1226–1232.

26. Barbalho SM, Goulart RA, Aranão ALC, de Oliveira PGC. Inflammatory Bowel Diseases and Fermentable Oligosaccharides, Disaccharides, Monosaccharides, and Polyols: An Overview. J Med Food 2018 Jul; 21(7): 633–640. https://doi.org/10.1089/jmf.2017.0120. Epub 2018 Jan 12. PMID: 29328869.

27. Barrett JS, Gibson PR. Development and validation of a comprehensive semi-quantitative food frequency questionnaire that includes FODMAP intake and glycemic index. J Am Diet Assoc 2010; 110: 1469–1476.

28. Gibson PR. Use of the low-FODMAP diet in inflammatory bowel disease. J Gastroenterol Hepatol 2017; 32 Suppl 1: 40–42.

29. Schwender B, Floch MH. Should FODMAP withdrawal be tried in inflammatory bowel disease patients with irritable bowel syndrome? J Clin Gastroenterol 2014; 48: 393–394.

30. Popa SL, Pop C, Dumitrascu DL. Diet Advice for Crohn›s Disease: FODMAP and Beyond. Nutrients 2020 Dec 6; 12(12): 3751.

31. Cox SR, Lindsay JO, Fromentin S, Stagg AJ, McCarthy NE, Galleron N, Ibraim SB, Roume H, Levenez F, Pons N, Maziers N, Lomer MC, Ehrlich SD, Irving PM, Whelan K. Effects of Low FODMAP Diet on Symptoms, Fecal Microbiome, and Markers of Inflammation in Patients with Quiescent Inflammatory Bowel Disease in a Randomized Trial. Gastroenterology 2020 Jan; 158(1): 176–188.e7.

32. Melgaard D, Sørensen J, Riis J, Ovesen TS, Leutscher P, Sørensen S, Knudsen JK, Bundgaard-Nielsen C, Ejstrup J, Jensen AM, Borre M, Krarup AL. Efficacy of FODMAP Elimination and Subsequent Blinded Placebo-Controlled Provocations in a Randomised Controlled Study in Patients with Ulcerative Colitis in Remission and Symptoms of Irritable Bowel Syndrome: A Feasibility Study. Nutrients 2022 Mar 18; 14(6): 1296.

33. Cox SR, Prince AC, Myers CE, Irving PM, Lindsay JO, Lomer MC, Whelan K. Fermentable Carbohydrates [FODMAPs] Exacerbate Functional Gastrointestinal Symptoms in Patients with Inflammatory Bowel Disease: A Randomised, Double-blind, Placebo-controlled, Cross-over, Re-challenge Trial. J Crohns Colitis 2017 Dec 4; 11(12): 1420–1429.

34. Kristianslund CH, Hatlebakk JG, Hausken T, Morken MH, Kahrs GE. PP083-SUN: Effect of Fodmap-Restricted DIET on Gastroesophageal Reflux Disease. Clinical Nutrition; 33: S50. Sep 2014. https://doi.org/10.1016/S0261-5614(14)50125-2.

35. Rivière P, Vauquelin B, Rolland E, Melchior C, Roman S, Bruley des Varannes S, Mion F, Gourcerol G, Sacher-Huvelin S, Zerbib F. Low FODMAPs diet or usual dietary advice for the treatment of refractory gastroesophageal reflux disease: An open-labeled randomized trial. Neurogastroenterol Motil 2021 Sep; 33(9): e14181.

36. Patcharatrakul T, Linlawan S, Plaidum S, Gonlachanvit S. The Effect of Rice vs. Wheat Ingestion on Postprandial Gastroesophageal Reflux (GER) Symptoms in Patients with Overlapping GERD-Irritable Bowel Syndrome (IBS). Foods 2021 Dec 23; 11(1): 26.

37. Staudacher HM. Nutritional, microbiological and psychosocial implications of the low FODMAP diet. J Gastroenterol Hepatol 2017 Mar; 32 Suppl 1: 16–19. https://doi.org/10.1111/jgh.13688. PMID: 28244658.

38. Catassi G, Lionetti E, Gatti S, Catassi C. The Low FODMAP Diet: Many Question Marks for a Catchy Acronym. Nutrients 2017 Mar 16; 9(3): 292. https://doi.org/10.3390/nu9030292. PMID: 28300773; PMCID: PMC5372955.

39. Hill P, Muir JG, Gibson PR. Controversies and Recent Developments of the Low-FODMAP Diet. Gastroenterol Hepatol (N Y) 2017 Jan; 13(1): 36–45. PMID: 28420945; PMCID: PMC5390324.