АРХИВИ НА ЈАВНОТО ЗДРАВЈЕ
ARCHIVES OF PUBLIC HEALTH

Vol. 16 No.1 2024

1924 - 2024

Институт за јавно здравје на Република Северна Македонија
Instituti i Shëndetit Publik i Republikës së Maqedonisë së Veriut
Institute for Public Health of the Republic of North Macedonia

Институт за јавно здравје на Република Северна Македонија
Institute for Public Health of the Republic of North Macedonia

Архиви на јавно здравје е медицинско научно списание кое го издава Институтот за јавно здравје на Република Северна Македонија

Archives of public health (**Arch Pub Health**) is a medical scientific journal published by Institute of public health of Republic NorthMacedonia

Уредник (**Editor**)
Гордана (Gordana) Ристовска (Ristovska)

Уредувачки одбор (**Editorial board**)
Шабан (Shaban) Мемети (Memeti) - Северна Македонија (North Macedonia)
Михаил (Mihail) Кочубовски (Kocubovski) – Северна Македонија (North Macedonia)
Владимир (Vladimir) Кендровски (Kendrovski) – Германија (Germany)
Лили (Lili) Стојановска (Stojanovska) - Австралија (Australia)
Горан (Goran) Белојевич (Belojevic) - Србија (Serbia)
Фимка (Fimka) Тозија (Tozija) - Македонија (North Macedonia)
Игор (Igor) Спироски (Spiroski)- Северна Македонија (North Macedonia) Елена (Elena) Ќосевска (Kosevska) – Северна Македонија (North Macedonia) Азиз (Aziz) Положани (Polozhani) - Северна Македонија (North Macedonia)
Константина (Konstandina) Кузевска Манева (Kuzevska Maneva) – Северна Македонија (North Macedonia)
Маријан (Marijan) Бошевски (Bosevski) – Северна Македонија (North Macedonia)
Љубица (Ljubica) Аргаласова (Argalášová) Соботова (Sobotová) – Словачка Илија (Ilija) Брчевски (Brcevski) - Србија (Serbia)
Сергеј (Sergej) Прijич (Prijic) – Србија (Serbia)
Мариана (Mariana) Голумбеану (Golumbeanu) – Романија (Romania) Каролина (Karolina) Љубомирова (Ljubomirova)– Бугарија (Bulgaria)
Насер (Naser) Рамадани (Ramadani)- Косово (Kosovo)
Сања (Sanja) Мусиќ (Music) Милановиќ (Milanovic) Хрватска (Croatia)

Лектор за македонски и англиски јазик
Ленче Даневска

Техничка подготовка
Владимир Хаџи Пулевски

CONTENT - СОДРЖИНА

PUBLIC HEALTH - ЈАВНО ЗДРАВЈЕ

DIABETES IN THE REPUBLIC OF NORTH MACEDONIA: EPIDEMIOLOGY AND ECONOMIC BURDEN, 2018-2021
Vjosa Recica, Zorica Naumovska

ДИЈАБЕТЕС ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА: ЕПИДЕМИОЛОГИЈА И ЕКОНОМСКО ОПТОВАРУВАЊЕ, 2018-2021
Вјоса Речица, Зорица Наумовска 5

LIFE HABITS AND SATISFACTION WITH HEALTH SERVICES BY THE ELDERLY IN THE REPUBLIC OF NORTH MACEDONIA
Jansun Bukovetz, Elena Kjosevska, Shaban Memeti, Vesna Velikj-Stefanovska, Stojan Gjoshev

ЖИВОТНИ НАВИКИ И ЗАДОВОЛНОСТ ОД ЗДРАВСТВЕНИТЕ УСЛУГИ НА СТАРИТЕ ЛИЦА ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА
Џансун Буковец, Елена Ќосевска, Шабан Мемети, Весна Велиќ Стефановска, Стојан Ѓошев 21

ANTIMICROBIAL SUSCEPTIBILITY OF *SALMONELLA ENTERITIDIS* ISOLATED IN THE PERIOD FROM 2020 TO 2022 IN THE SHTIP REGION
Kristina Sudiklieva, Golubinka Boshevska, Maria Dimitrova, Dragan Kochinski

АНТИМИКРОБНА ОСЕТЛИВОСТ НА SALMONELLA ENTERITIDIS ИЗОЛИРАНА ВО ПЕРИОДОТ ОД 2020 ДО 2022 ГОДИНА ВО ШТИПСКИОТ РЕГИОН
Кристина Судиклиева, Голубинка Бошевска, Марија Димитрова, Драган Кочински 38

ASSESSMENT OF THE BURDEN OF SALMONELLOSIS IN THE REPUBLIC OF NORTH MACEDONIA
Aneta Kostova, Gordana Ristovska, Darko Kotev

ПРОЦЕНКА НА ОПТОВАРУВАЊЕТО СО САЛМОНЕЛОЗА ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА
Анета Костова, Гордана Ристовска, Дарко Котев 44

LEGAL REGULATION OF HEALTH SPECIALIZATIONS AND SUBSPECIALIZATIONS IN THE FIELD OF DENTISTRY IN THE REPUBLIC OF NORTH MACEDONIA
Vlatko Kokolanski, Kjiro Ivanovski, Julijana Nikolovska, Mira Jankulovska

ПРАВНА РЕГУЛАЦИЈА НА ЗДРАВСТВЕНИТЕ СПЕЦИЈАЛИЗАЦИИ И СУПСПЕЦИЈАЛИЗАЦИИ ОД ОБЛАСТА НА СТОМАТОЛОГИЈАТА ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА
Влатко Коколански, Ќиро Ивановски, Јулијана Николовска, Мира Јанкуловска 56

CLINICAL SCIENCE- КЛИНИЧКИ ИСТРАЖУВАЊА

ECONOMIC EVALUATION OF COST-EFFECTIVENESS IN EARLY VERSUS DELAYED LAPAROSCOPIC CHOLECYSTECTOMY IN ACUTE CHOLECYSTITIS
Rexhep Selmani, Qemal Rushiti, Andrea Nikolovski, Shaban Memeti, Arian Selmani

ЕКОНОМСКА ЕВАЛУАЦИЈА НА ТРОШОЦИ- ЕФЕКТИВНОСТ КАЈ РАНАТА НАСПРОТИ ОДЛОЖЕНА ЛАПАРОСКОПСКА ХОЛЕЦИСТЕКТОМИЈА КАЈ АКУТЕН ХОЛЕЦИСТИТ
Рецеп Селмани, Ќемал Рушити, Андреа Николовски, Шабан Мемети, Аријан Селмании 76

PUBLIC HEALTH

DIABETES IN THE REPUBLIC OF NORTH MACEDONIA: EPIDEMIOLOGY AND ECONOMIC BURDEN, 2018-2021

Vjosa Recica[1], Zorica Naumovska[2]

[1] *Institute of Public Health of the Republic of North Macedonia, Skopje, Republic of North Macedonia*

[2] *Faculty of Pharmacy, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia*

Citation: Recica V, Naumovska Z. Diabetes in the Republic of North Macedonia: epidemiology and economic burden, 2018-2021. Arch Pub Health 2024; 16(1). 5:20.

doi.org/10.3889/aph.2024.6117

Key words: diabetes, mortality, morbidity, health care costs

***Correspondence:** Vjosa Recica, Institute of Public Health of the Republic of North Macedonia, Skopje, Republic of North Macedonia

E-mail: vjosa.recica@gmail.com

Received: 15-Dec-2023; **Revised:** 13-Mar-2024; **Accepted:** 2-Apr-2024; **Published:** 01-Jul-2024

Copyright:© 2024. Vjosa Recica , Zorica Naumovska. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

Competing Interests: The author have declared that no competing interests

Abstract

Diabetes is a chronic, metabolic disease with hyperglycemia caused by defects in insulin secretion, insulin action, or both, results in dysfunction and failure of various organs, reduced quality of life, increased medical costs, reduced productivity and premature mortality in diabetic patients. The main goal of the study is presentation of epidemiological data for diabetes, evaluation of complications associated with the disease and economic burden of diabetes in the Republic of North Macedonia. Materials and methods: A retrospective epidemiological study based on prevalence data from the Diabetes Registry in the Republic of North Macedonia, as well as data from primary and specialized healthcare centers was conducted. It combined population demographics in our country in 2021 with epidemiological data for diabetes, as well as healthcare costs associated with diabetes obtained from WHO, Institute of Health Metrics and Evaluation and National Health Insurance Fund. Results: The incidence rate of type 1 diabetes (T1DM) in the Republic of North Macedonia was presented with 1.21‰ newly diagnosed in 2018 and 2.8‰ in 2021 with is highest rate in the age group of youths from 10-14 (12.4‰) in 2021. In time period 2018-2021, the incidence rate of patients with type 2 diabetes (T2DM) also enlarged from 323.3‰ to 355.5‰, while the prevalence rate increased from 5554.4‰ to 6549.3‰. The highest prevalence rates for T2DM analyzed by age were observed in age groups between 55 and 79 years. The highest rate of diabetes-associated complications in North Macedonia are complication on peripheral circulation, followed by ketoacidosis, neurological complications, ophthalmic complication, diabetic coma and multiple complications. The percentage of prescriptions for blood glucose lowering drugs (excluding insulin) in our country rose form 7.3% in 2018 up to 7.6% in 2020, whereas the cost of provision of diabetes treatment supplies in 2021 for patients on insulin amounted to approximately 13,457,508,62 USD. The calculated burden of diabetes mellitus and diabetic complications in the Republic of North Macedonia amounted to 42,806.59 disability-adjusted life-years (DALYs). Conclusions: Diabetes rates are increasing worldwide and in the Republic of North Macedonia, too. This epidemiological study is a solid base for implementation of the national strategy for diabetes and will contribute in effective planning and evaluation of all aspects of diabetes control in the Republic of North Macedonia.

ЈАВНО ЗДРАВЈЕ

ДИЈАБЕТЕС ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА: ЕПИДЕМИОЛОГИЈА И ЕКОНОМСКО ОПТОВАРУВАЊЕ, 2018-2021

Вјоса Речица[1], Зорица Наумовска[2]

[1] *Институт за јавно здравје на Република Северна Македонија, Скопје, Република Северна Македонија*

[2] *Фармацевтски факултет, Универзитет "Св. Кирил и Методиј" во Скопје, Република Северна Македонија*

Цитирање: Речица В, Наумовска З. Дијабетес во Република Северна Македонија: епидемиологија и економско оптоварување, 2018-2021. Арх Ј Здравје 2024;16(1) 5:20.

doi.org/10.3889/aph.2024.6117

Клучни зборови: дијабетес, морталитет, морбидитет, трошоци за здравствена заштита

***Кореспонденција:** Вјоса Речица, Институт за јавно здравје на Република Северна Македонија, Скопје, Република Северна Македонија. E-mail: vjosa.recica@gmail.com

Примено:15-дек-2023; **Ревидирано:**13-мар-2024; **Прифатено:** 2-апр-2024; **Објавено:** 01-јули-2024

Печатарски права: ©2024. Вјоса Речица, Зорица Наумовска. Оваа статија е со отворен пристап дистрибуирана под условите на нелокализирана лиценца, која овозможува неограничена употреба, дистрибуција и репродукција на било кој медиум, доколку се цитираат оригиналниот(ите) автор(и) и изворот.

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Извадок

Дијабетесот е хронична, метаболична болест со хипергликемија предизвикана од промени во инсулинската секреција, дејството на инсулинот или и на двата фактора, што резултира со нарушување на физиолошката функција на многу органи и нивно потенцијално откажување, што, пак, резултира со намалување на квалитетот на животот на пациентите, зголемување на медицинските трошоци, намалување на продуктивноста и прерана смртност кај пациентите со дијабетес. Главна цел на студијата е презентација на епидемиолошки податоци за дијабетесот, евалуација на компликации поврзани со болеста и економско оптоварување од дијабетесот во Република Северна Македонија. Материјали и методи: Спроведена е ретроспективна епидемиолошка студија базирана на податоци за преваленција од Регистарот за дијабетес во Република Северна Македонија, како и податоци од примарни и специјализирани здравствени центри. Ги комбинира демографијата на населението во нашата земја во 2021 година со епидемиолошки податоци за дијабетес, како и трошоци за здравствена заштита поврзани со дијабетес добиени од СЗО, Институтот за здравствена метрика и евалуација и Националниот фонд за здравствено осигурување. Резултати: Стапката на инциденција на дијабетес тип 1 (Т1ДМ) во Република Северна Македонија е претставена со 1,21‰ новодијагностицирани во 2018 година и 2,8‰ во 2021 година со највисока утврдена стапка кај возрасната група на млади од 10-14 години (12,4‰) во 2021 година. Во временскиот период 2018-2021 година, стапката на инциденција на пациенти со дијабет тип 2 (Т2ДМ) исто така се зголемила од 323,3‰ на 355,5‰, додека стапката на преваленција се зголемила од 5554,4‰ на 6549,3‰. Највисоките стапки на преваленција за Т2ДМ анализирани според возраста беа забележани во возрасните групи помеѓу 55 и 79 години. Највисока стапка на компликации поврзани со дијабетес во Северна Македонија се компликации на периферната циркулација, по што следуваат кетоацидоза, невролошки компликации, офталмолошки компликации, дијабетична кома и повеќекратни компликации. Процентот на рецепти за лекови за намалување на гликозата во крвта (кај пациенти што не се на инсулин) во нашата земја се зголемил од 7,3% во 2018 година на 7,6% во 2020 година, додека трошоците за обезбедување средства за третман на дијабетес во 2021 година за пациенти на инсулинска терапија изнесувале приближно 13.457.50 ,62 американски долари. Пресметаниот товар на дијабетес мелитус и дијабетични компликации во Република Северна Македонија изнесува 42.806,59 disability-adjusted life-years (години на животот приспособени на неспособност/попреченост) (DALYs). Заклучоци: Стапките на дијабетес се зголемуваат во светот, како и во Република Северна Македонија. Оваа епидемиолошка студија е солидна основа за имплементација на националната стратегија за дијабетес и ќе придонесе во ефективно планирање и евалуација на сите аспекти на контролата на дијабетесот во Република Северна Македонија.

Introduction

Diabetes is a chronic, metabolic disease characterized by hyperglycemia caused by defects in insulin secretion, insulin action, or both, which leads over time to serious damage, dysfunction and failure of various organs[1]. Several pathogenic processes that destroy pancreatic beta cells with subsequent insulin deficiency, and others that result in resistance to insulin action are involved in the development of diabetes[2].

Diabetes mellitus can be categorized into the following main types:

a) Type 1 diabetes (T1DM), caused by the autoimmune destruction of beta cells, leading to an absolute insulin deficiency, including latent autoimmune diabetes in adulthood.

The etiology of T1DM has still not been fully understood although several factors have been identified such as genetic factors, environmental factors, and viral infections. Type 1 diabetes mellitus is considered as a cell-mediated autoimmune destruction of insulin-secreting cells in the pancreas. Although the autoimmune process begins many years before clinical detection and presentation, the destruction remains undetected because 10-20% of beta-cell volume is sufficient to cover the clinical symptoms. The rate of beta-cell destruction varies significantly, being rapid in some individuals (mainly infants and children) and typically slow in adults[3].

b) Type 2 diabetes (T2DM), characterized by the progressive loss of suitable insulin secretion from beta cells, which could result in complete lack of insulin production, often accompanied with insulin resistance[4]. A pre-diabetic stage characterized with high blood glucose levels is a common stage in patients before the diagnosis of T2DM. Recent studies have shown that certain long-term damages to the body, particularly the heart and circulatory system, may already occur during this stage[5].

c) Specific types of diabetes due to other causes, such as monogenic diabetes syndromes (including neonatal diabetes and maturity-onset diabetes in the young), diseases of the exocrine pancreas (such as cystic fibrosis and pancreatitis), and drug-induced or chemical diabetes (as seen with the use of glucocorticoids, in HIV/AIDS treatment, or after organ transplantation), etc.[6].

d) Gestational diabetes mellitus: diagnosed in the second or third trimester of pregnancy, which was not clearly present before pregnancy[7].

Risk factors for T1DM include family history, race, and certain viral infections in childhood. The incidence rate of T1DM varies significantly worldwide and depends on the interaction between genetic susceptibility and specific environmental factors. Recently, it has been proven that low socioeconomic status is associated with higher rates of morbidity and mortality in patients with T1DM[8].

Risk factors for T2DM are diverse, with some being modifiable, while others are not. Non-modifiable risk factors for T2DM include age, race or ethnic background, family history (genetic predisposition), history of gestational diabetes, and low birth weight. The incidence and prevalence of diabetes increase with age. Modifiable risk factors or lifestyle factors that contribute to onset of T2DM include increased body mass

index (BMI), physical inactivity, poor diet, and hypertension, smoking, and alcohol consumption, among others[9]. Increased BMI, as well as an increased waist-to-hip ratio are recognized as high risk factors for diabetes[10]. Additionally, it is well-established that obesity is a major contributor to insulin resistance and T2DM[11]. Increased demand for insulin can be copped by improving the release activity of the pancreatic beta cells. However, when release capacity of beta cells is not modified, progressive deficiency of insulin and insulin resistance occur, leading to T2DM and abnormalities in carbohydrate, protein, and fat metabolism[12-14].

High morbidity and mortality in diabetic patients are presented in many cross-sectional studies and are a result of common microvascular and macrovascular complications identified in patients with T1DM or T2DM[15,16]. Microvascular complications include peripheral neuropathy with a risk of foot ulcers, amputations, and joint problems; autonomic neuropathy can cause gastrointestinal, genitourinary, cardiovascular symptoms, sexual dysfunction and retinopathy, with the potential of vision loss; nephropathy that can cause renal insufficiency, while macrovascular complications consist of cardiovascular diseases, stroke, cerebrovascular diseases and peripheral arterial disease[17]. There are other complications of diabetes that cannot be included in the aforementioned categories, such as dental diseases, decreased resistance to infections, and complications during childbirth in women with gestational diabetes[18].

Chronic complications are the primary outcome of the progression of T2DM, reducing patients' quality of life, burdening healthcare systems, and increasing mortality among diabetics[19]. After adjusting for age, the mortality rate among people with T2DM is approximately twice that of their non-diabetic peers[20,21]. Approximately 50-80% of all individuals with diabetes die from cardiovascular diseases, cerebrovascular diseases, and renal insufficiency, which are leading causes of death[22,23].

The economic burden of diabetes mellitus is enormous having a significant impact on patients, healthcare providers and national healthcare systems, particularly in low and middle-income countries[24,25]. The estimated total cost of diagnosed diabetes in 2017 was 327 billion dollars, including 237 billion US dollars in direct medical costs and 90 billion dollars in reduced productivity. The largest components of direct medical costs are hospital inpatient care (30% of total medical costs), prescription medications for diabetes complications (30%), antidiabetic agents, and diabetes supplies (15%), and physician visits (13%). Indirect costs include increased absenteeism from work (3.3 billion dollars), reduced productivity at work (26.9 billion dollars) for employed individuals, reduced productivity for those not in the workforce (2.3 billion dollars), work disability due to disease-related disability (37.5 billion dollars), and lost productive capacity due to premature mortality (19.9 billion dollars)[26,27]. The poor disease management usually results in increased hospital admissions, accounting for over 40% of the costs attributed to diabetes[28].

Collection of relevant epidemiological data, identification of specific risk factors for increased morbidity and mortality in diabetes patients, evaluation of national economic burden of the disease and implementation of appropriate strategy for prevention, treatment and improved quality of life for patients with diabetes is a challenging process and strategic approach is inevitable[29]. The main goal of the study is presentation of epidemiological data for diabetes, evaluation of complications associated with the disease and economic burden of diabetes in the Republic of North Macedonia. These data are a solid base for implementation of national strategy for diabetes and will help in designing of educational programs/interventions for improved prevention and treatment strategies for diabetes in our country.

Materials and methods

The study employed a retrospective epidemiological approach based on prevalence data taken from the Diabetes Registry of the Institute of Public Health of the Republic of North Macedonia, as well as data from primary healthcare centers and specialized services. It combined population demographics in our country in 2021 with epidemiological data for diabetes, as well as healthcare costs associated with diabetes obtained from WHO, Institute of Health Metrics and Evaluation and National Health Insurance Fund.

Results

The estimated prevalence in Macedonia in 2019, according to International Federation of Diabetes, was higher than the world average and amounted to 11.44%, which corresponded to 188.8 thousand people aged 20-79, or every ninth adult in Macedonia had diabetes (Table 1). National prevalence in North Macedonia in 2021 among people aged 20 to 79 years was 12.44% or 180.180 patients with diagnosed and undiagnosed diabetes mellitus 43.8% of them were patients with diabetes on insulin therapy in 2021[30].

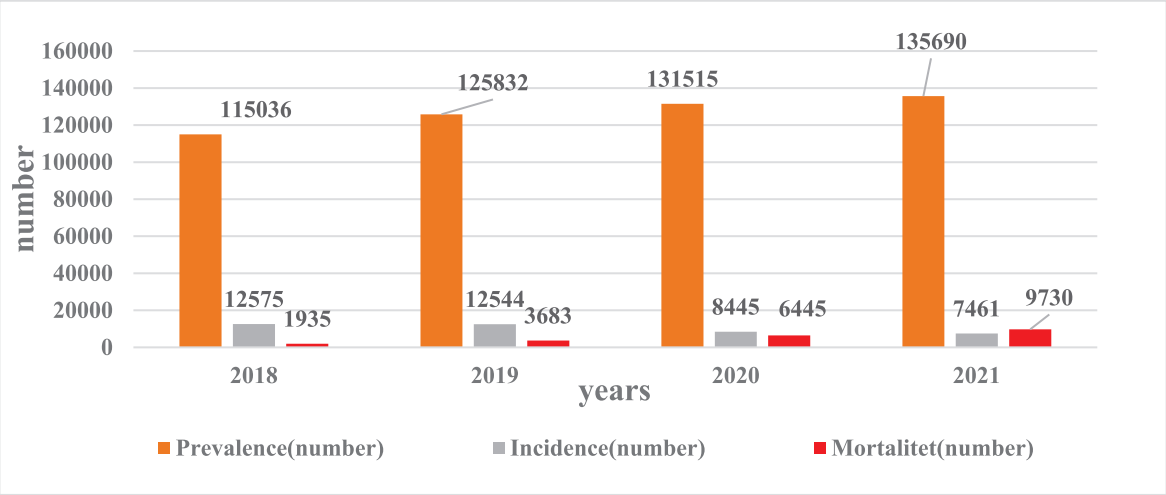
Table. 1 National data for T2DM in 2021

Total Population	**2.058.539**
National prevalence (20-79 yrs.)	**12.44%**
Comparative prevalence of diabetes (adapted according to age)	9.76%
Total patients with diabetes (both diagnosed and undiagnosed)	180.180
Patients with diagnosed diabetes	84.568 (46.9% of total patients)
Patients with diabetes on insulin therapy	37.011 (43.8% of diagnosed patients)
Patients with diabetes treated with insulin and analogues	27.370 (74.0% insulin dependent)
Patients with type 1 diabetes	2.300 (1.3% of total patients)
Patients with type 1 diabetes on an insulin pump	172 (7.5% of type one diabetes)

Sources: e-health, 2021

The analysis of the individual record from the National Register for Diabetes Mellitus confirmed increase of number of diabetic patients from 115,036 in 2018 up to 135,690 in 2021 presenting 6.6% of population. The mortality increased in the same period and was presented with 1,935 deaths vs. 9,730 in 2018 and 2021, respectively (Figure 1).

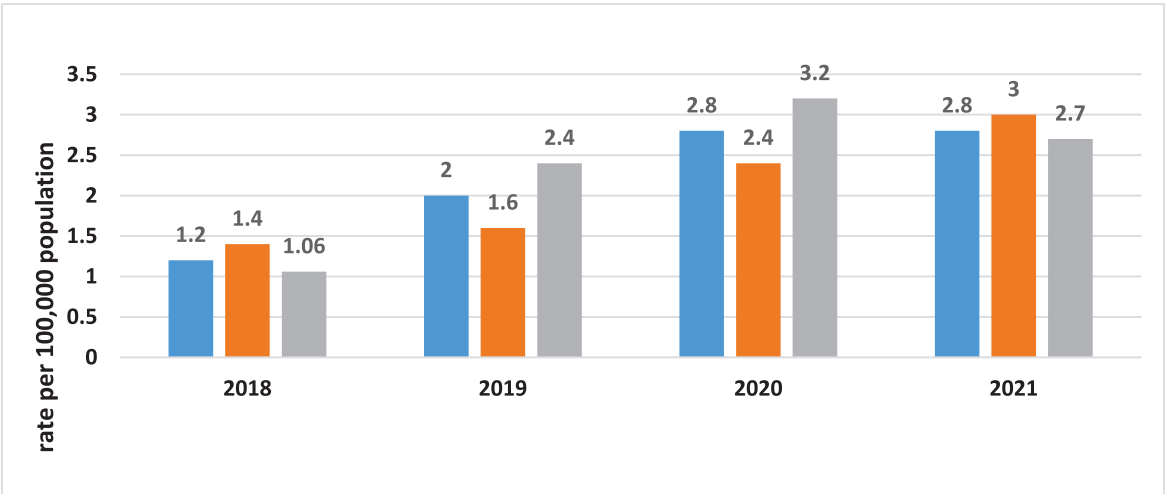
Figure 1. Incidence, prevalence and mortality of diabetes in the Republic of North Macedonia, 2018-2021



The official date suggests that the rate of newly diagnosed cases of diabetes (all diagnoses) in 2021 was 406.1, compared to 684.65 in 2018 per 100,000 population. Out of 135,690 patients with diabetes registered in 2021, 75,820 were male and 59,870 female.

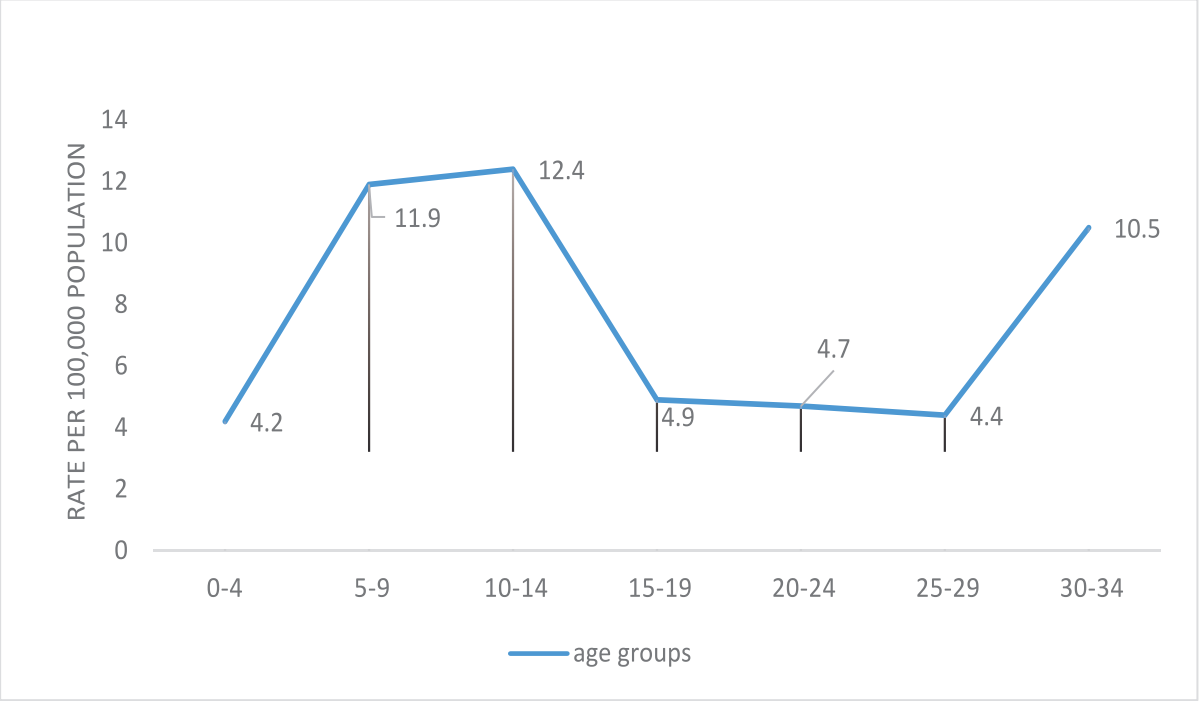
The incidence rate of newly diagnosed patients with T1DM in 2018 was 1.21%ooo, presented with 1.4%ooo in males and 1.06% in females, while in 2021 the incidence rate of T1DM increased up to 2.8%ooo (3%ooo in males and 2.7%ooo in females) (Figure 2).

Figure 2. Incidence rate of T1DM per 100,000 population, analyzed by gender



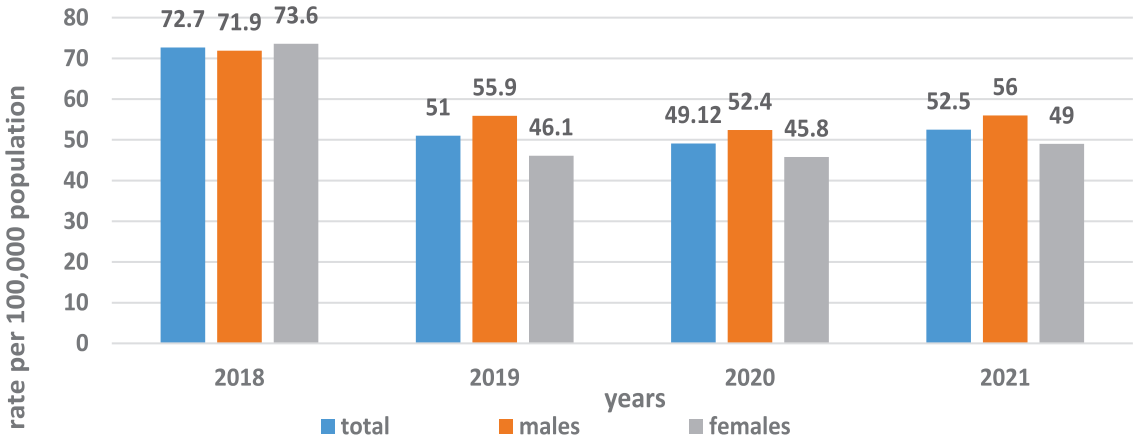
The rate of new cases of T1DM in North Macedonia in youths younger than 20 years was highest in the age groups from 10-14 (12.4%ooo). The total number of children aged 0–14 years diagnosed with T1DM in this period was 45, of which 25 (61.4%) were boys, and 15 (49.6%) were girls. The average age at which diabetes mellitus was diagnosed was 7.8 years.

Figure 3. Incidence rate of DMTB1 per 100,000 population, analyzed by age in 2021



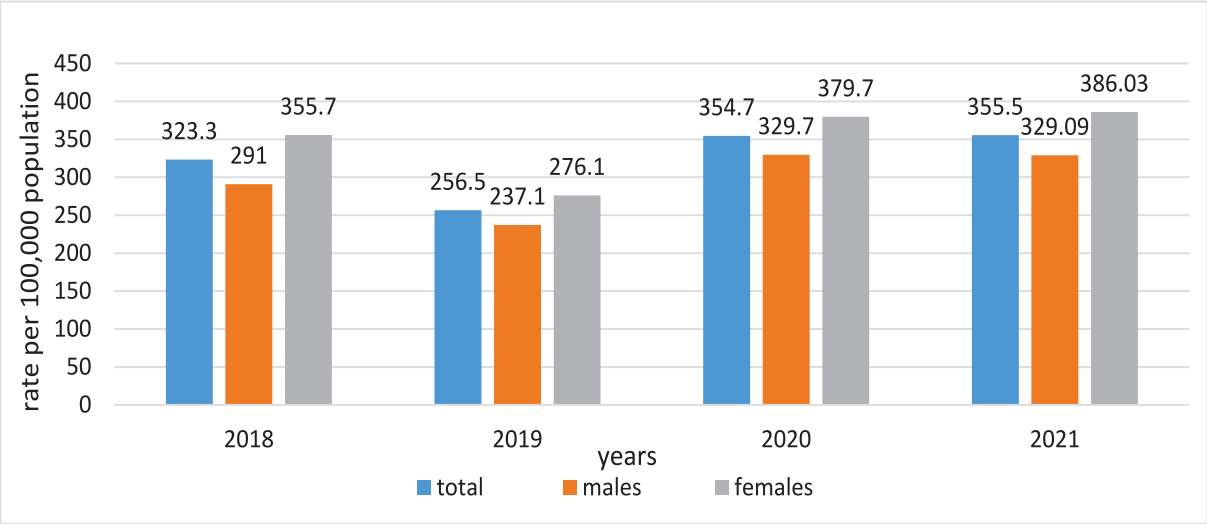
In 2018 the prevalence of diagnosed T1DM in the Republic of North Macedonia was 72‰ presented with higher rate of 73.6‰ in females and 71.9‰ in males. In the period from 2018 to 2021 the prevalence rate decreased for 19.5‰ and in 2021 it was 52.5‰ in the total population (56‰ in females and 49‰ in males).

Figure 4. Prevalence rate per 100,000 population of T1DM, analyzed by gender



The incidence rate of T2DM was higher in women in the evaluated period compared to men. The Incidence rate of T2DM in 2018 in the total population was 323.3‰, with a higher rate in females (355.7‰) than in males (291‰), rising up the rate of 355.5‰ (386.03‰ female vs. 329.09‰ male) in 2021.

Figure 5. Incidence rate per 100,000 population of T2DM, analyzed by gender



The highest incidence of diabetes mellitus in the period 2018-2021 was found in people aged between 55-74 years, and the incidence was approximately 8% higher in males compared to females (Figure 6).

Figure 6. Incidence rate per 100,000 population of T2DM, analyzed by age

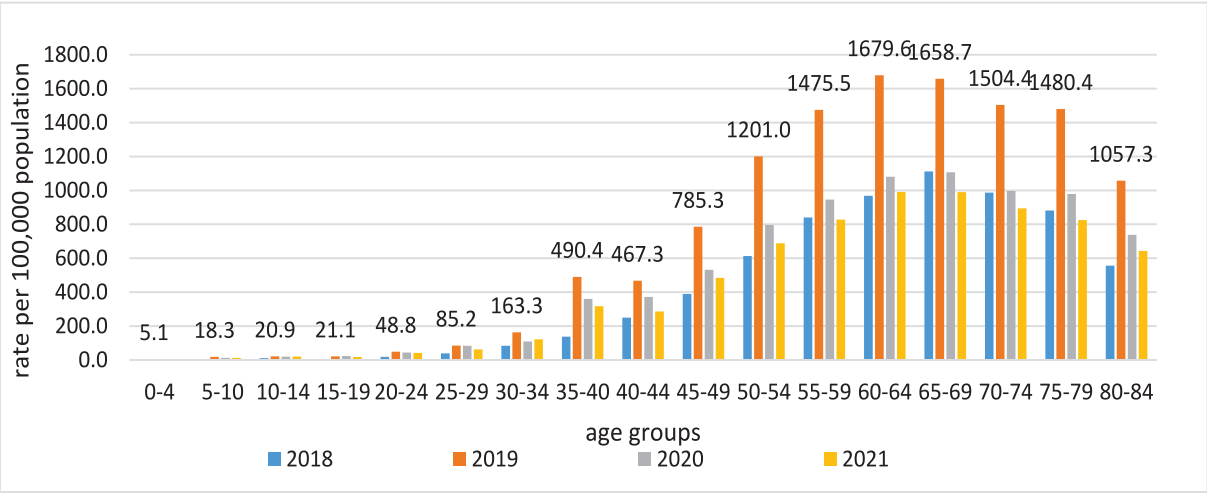
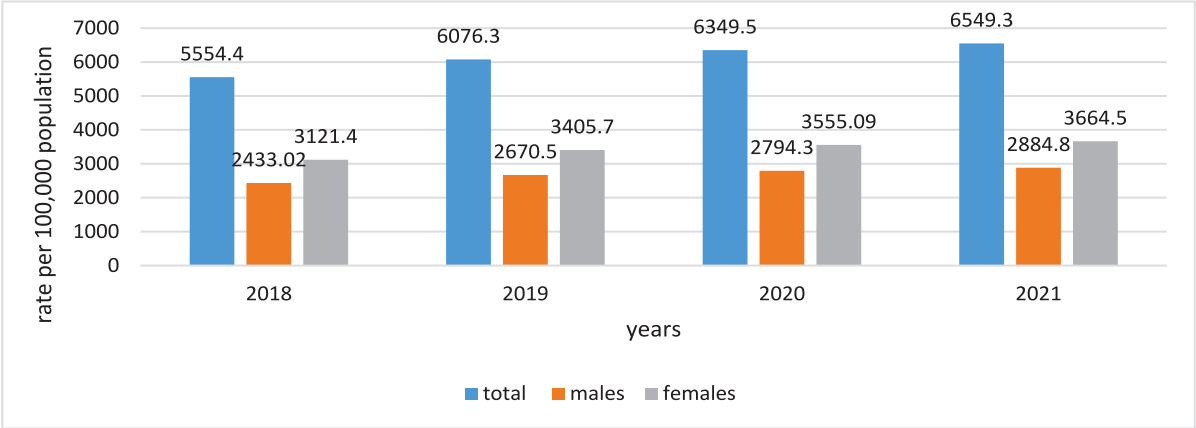


Figure 6 presents incidence rates for T2DM analyzed by age, with higher rates seen in age groups from 55-79, (1475.5 per 100,000 in 55-59), (1679.6 per 100,000, in 60-64), (1658.7 per 100,000, in 65-69), (1504.4 per 100,000, in 70-74) and (1480.4 per 100,000 in 75-79). Higher prevalence rate was found in women compared to men.

The reported prevalence of diagnosed diabetes in 2018 was approximately 5554.4‰, with 3121.4‰ in females (56.2%) and 2433.03‰ in males (44.8%). In the evaluated period (2018-2021) prevalence rate increased by 8.4%, rising up to 6549.3‰ in 2021 in the total population, presented with 3664.5 in females (55.9%) and 2884.8‰ (44.1%) in males (Figure 7). The average prevalence rate in the four-year period was 6132.1‰.

Figure 7. Prevalence rate per 100,000 population of T2DM, analyzed by gender



The highest prevalence rates for T2DM analyzed by age were observed in the age groups 50-59, 70-79, and 80 years and older (10721.3 per 100,000 - 55+), (27520.1 per 100,000 75-79), (33760.7 per 100,000 - 80+), respectively (Figure 8).

Figure 8. Prevalence rate per 100,000 population of T2DM, analyzed by age

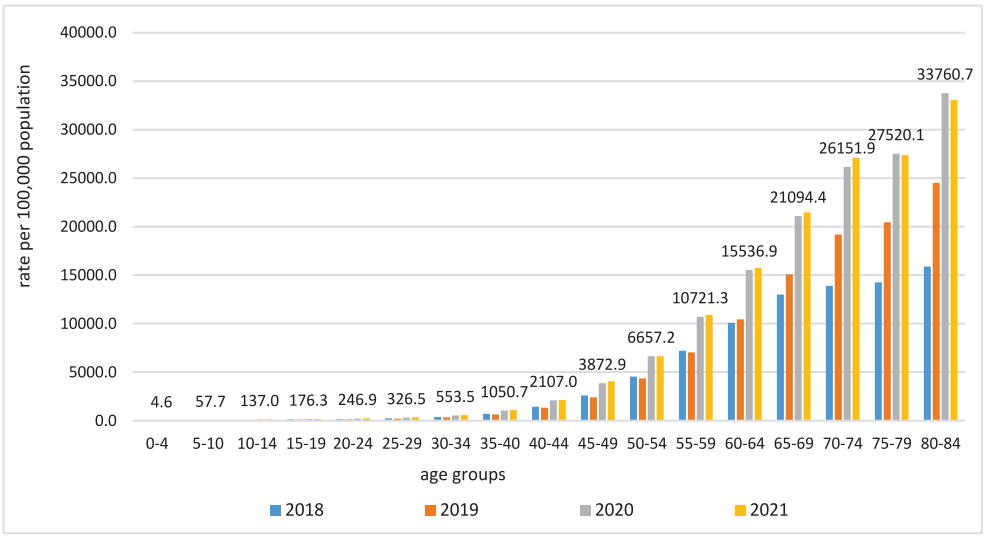


Figure 9. Complication prevalence rates related to diabetes mellitus per 100,000 population

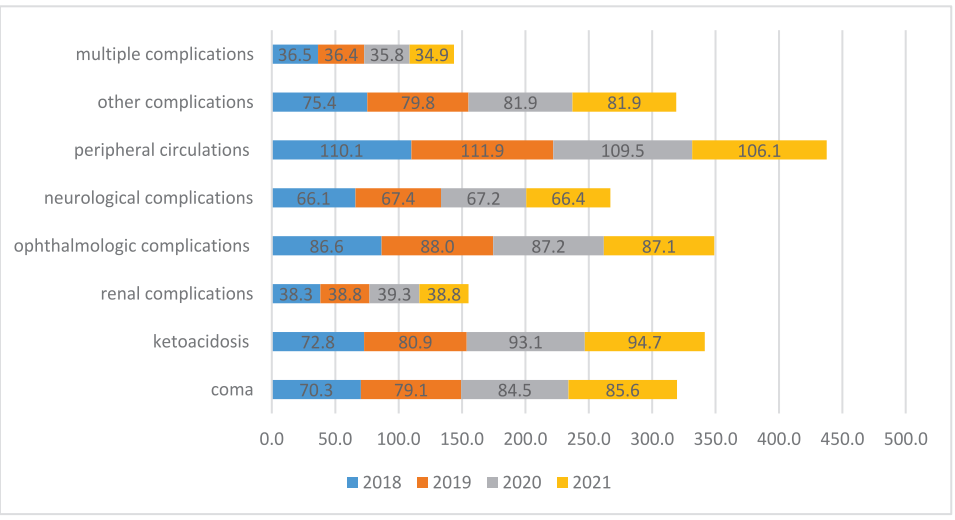
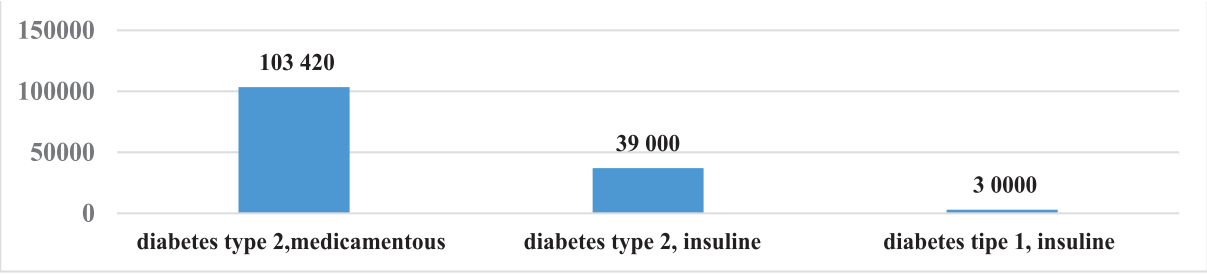


Figure 9 presents the results of complication rates associated with diabetes including peripheral complications, ophthalmologic complications, renal complications, ketoacidosis, coma, and multiple complications. The highest rate of diabetes-associated complications in the Republic of North Macedonia were complications of the peripheral circulation (110.1‰ in 2018 and 106.1‰ in 2021). In the evaluated 4-year period, complications related to ketoacidosis raised from 72.8‰ in 2018 to 85.6‰ in 2021.

The official data from the Ministry of Health in the Republic of North Macedonia in 2021 show that approximately 103,420 patients were on non-insulin antidiabetic treatment and 42,000 (3,000 with T1DM and 39,000 with T2DM) were on insulin therapy (Figure 10).

Figure 10. Registered number of patients diagnosed with diabetes mellitus on antidiabetic treatment and on insulins



Based on the provided data from the National Insurance Fund of North Macedonia, in 2018 there were 1.735.520 prescriptions for blood glucose lowering drugs (excluding insulin) released, accounting for 7.3% of the total number of prescriptions. In 2020, the number of prescriptions for blood glucose lowering drugs (excluding insulin) rose to 1.836.037, accounting for 7.6% of the total number of prescriptions. This indicates a significant increase in the number of prescriptions for blood glucose lowering drugs over the evaluated period, which may reflect an increase in the prevalence or management of diabetes in North Macedonia during that time [31].

The cost of provision of diabetes treatment supplies in 2021, including insulins, glucagon, insulin pumps, glucometers, and other consumables related to insulin treatment of patients on insulin in 2021 amounted to 759,655,000.00 denars, which is approximately 13.457.508,62 USD.

The Global Burden of Diseases (GBD), Injuries and Risk Factors Study generates publicly available estimates of total diabetes deaths, prevalence, years of life lost (YLLs), years lived with disability (YLDs), and disability-adjusted life-years (DALYs) at the global, super-region, region, and country and territory levels. The calculated burden of diabetes mellitus and diabetic complications in the Republic of North Macedonia amounts to 42,806.59 DALYs. This includes 20,671.47 DALYs for males and 22,135.12 DALYs for females. Out of the total DALYs, 20,453.71 are years of healthy life lost due to premature death (YLLs), and another 22,135.12 are years of healthy life lost due to disability (YLDs) caused by diabetes and its complications. The most vulnerable age groups are adults aged 45 to 79 years, which collectively

account for 86.46% of the burden. Percentage change in DALYs count was 153.4% (116.8 to 190.3). In 2021 age standardized DALYs rate (per 100,000) for North Macedonia was 1268.1 highest for 28% compared to Global range (915.0).

Table 2. Disability-adjusted life years (DALYs) globally and in North Macedonia

Country	DALY count in 2021 (thousands)	Percentage change in DALY count, 1990–2021 (%)	Age-standardised DALY rate in 2021 (per 100,000)	Percentage change in age-standardised DALY rate, 1990–2021 (%)
Global	79 200 (67 800 to 92 500)	189.8% (171.1 to 203.4)	915.0 (782.6 to 1067.4)	38.6% (29.7 to 45.3)
Central Europe	1550 (1250 to 1890)	73.7% (63.6 to 82.0)	748.1 (598.1 to 913·2)	23.0% (15.3 to 29.4)
Albania	17.8 (13.7 to 23.2)	147.8% (119.1 to 175.6)	417.5 (323.5 to 544.8)	26.9% (12.3 to 40·5)
Bosnia and Herzegovina	75.2 (61.2 to 91.0)	171.1% (134.0 to 204.2)	1253.6 (1022.6 to 1527.9)	88.3% (62.4 to 111.5)
Bulgaria	115 (89.8 to 138)	35·5% (23.2 to 48.7)	868.1 (675.6 to 1051.7)	24.6% (13.5 to 36.2)
Croatia	62.7 (49.6 to 75.9)	73.0% (58.1 to 84.2)	743.1 (580.3 to 903·3)	29.7% (18.3 to 37.8)
Czech Republic	171 (136 to 211)	106.7% (87.4 to 125.6)	829.8 (659.6 to 1029.7)	35.7% (22.9 to 47.6)
Montenegro	8.79 (7.12 to 10.7)	118.1% (95.9 to 139.0)	896.2 (728.1 to 1091·2)	39.7% (26.3 to 52.0)
North Macedonia	41.7 (32.6 to 51.1)	153·4% (116.8 to 190.3)	1268.1 (1000.4 to 1554.4)	46·4% (26.1 to 68.5)

Source: Institute for Health Metrics and Evaluation (IHME), Seattle

Discussion

Worldwide, approximately 537 million adults (aged 20-79) live with diabetes – about 1 in 10 people. This number is projected to increase to 643 million by 2030 and 783 million by 2045. Over 3 of 4 adults with diabetes live in low and middle-income countries. The increase of number of diabetic patients was confirmed in the evaluated 2018 – 2021 period in our study and the official data suggests that in 2021 6.6% of the population in North Macedonia was living with diabetes. Diabetes was accountable for 6.7 million deaths in 2021 – 1 death every 5 seconds. The results obtained in our study also suggest huge amplification of mortality in patients with diabetes, from 1935 in 2018 to 9730 in 2021. Approximately 541 million adults worldwide have impaired glucose tolerance (IGT), putting them at high risk of type 2 diabetes. The percentage of people with undiagnosed diabetes (predominantly type 2) was 50.1% in 2021, or 231.9 million undiagnosed patients globally, and in North Macedonia this percentage was 39.6%[32].

The incidence rate of T1DM in the Republic of North Macedonia increased for more than 100% and was presented with 1.21%ooo newly diagnosed in 2018 and 2.8%ooo in 2021, with the highest rate in the age group of youths from 10-14 (12.4%ooo) in 2021. In 2018, the prevalence rate in the Republic of North Macedonia was 72%ooo (73.6%ooo in females and 71.9%ooo in males). A declination of the prevalence rate of T1DM in 2021 was observed - 52.5%ooo (56%ooo in females and 49%ooo in males).

In the period 2018-2021, the incidence rate of patients with T2DM also enlarged from 323.3%ooo to 355.5%ooo, while the prevalence rate increased from 5554.4%ooo to 6549.3%ooo. Higher incidence and prevalence rate in the four-year period was confirmed in females compared to males. The prevalence of diabetes increases with age, with the highest estimated prevalence in the population aged over 65 years. The prevalence of diabetes among people aged 20 to 79 years in Europe is estimated to be 59.3 million, representing 8.9% of the population in this age group, including 24.2 million adults with undiagnosed diabetes. In 2019, there were 704.4 million people in the age groups over 65, of which 135.6 million had diabetes[33,34]. In line with all global trends, in our study the highest incidence rate was found in people aged between 55-79 years. In the evaluated subgroups of patients with T2DM, the highest incidence rate was observed in 2019. These results are due to establishment and implementation of updated protocols by National Institute of Health resulting in better statistical recording and evaluation of diabetic patients. Unfortunately, as a result of the COVID-19 pandemic and nonadherence to protocols in years 2020 and 2021 a decreased rate in subgroups of patients with diabetes was confirmed in comparison to 2019. The obtained results suggest inevitable improvement of adherence to the protocols for diabetic patients recoding in order to improve planning and implement the National strategy for diabetes in our country. The highest prevalence rates for T2DM analyzed by age were observed in the age above 50, as presented in the study (10721.3 per 100,000 - 55+), (27520.1 per 100,000 75-79) and (33760.7 per 100,000 - 80+).

The highest rate of diabetes-associated complications in North Macedonia were complications of peripheral circulation (110.1%ooo in 2018 and 106.1%ooo in 2021). In the evaluated 4-year period, the complications related to ketoacidosis raised from 72.8%ooo to 85.6%ooo in 2018 and in 2021, respectively, followed by neurological complications, ophthalmic complications, diabetic coma and multiple complications. These common microvascular and macrovascular complications in patients with diabetes type 1 or type 2 are related to the high morbidity and mortality in diabetic patients and our results are in line with the results from other cross-sectional studies[15,16].

According to WHO estimates, out of 995.2 million adults in 2030 in Europe, 195.2 million will have diabetes, and by 2045, out of 1.4 billion adults, 276.2 million are expected to have diabetes. The International Diabetes Federation (IDF) gener-

ates worldwide estimates of diabetes deaths and prevalence for type 1 diabetes in people aged 19 years or younger and for total diabetes in those aged 20–79 years, with the most recent estimates produced in 2021, and has projected the future prevalence of total diabetes through 2045. The data obtained from the International Diabetes Federation, from year 2011 suggested 33.7% of people with impaired fasting glucose in North Macedonia with the estimated increase of these percentage by 36.8% in 2030 33. Evaluation of data from the National diabetes registry have confirmed some inconveniences regarding the quality of mandatory requirements for follow up of patients with diabetes resulting in some gaps in presented analysis, which is recognized as one of the main limitations of our studies. Identification of missing data for fasting glucose levels and HbA-1c in the National diabetes registry resulted in recommendation initiated by the Institute for Public Health for inclusion of additional laboratory results in order to identify prediabetes (fasting glucose levels, HbA-1c glucose level, etc.)[35].

If diet and exercise fail to maintain HbA-1c to the target, then the treatment algorithm in the management guidelines recommends starting with monotherapy, then progressing to combination therapy (dual or triple), and eventually to insulin. The number of available options for treatment of T2DM has been continuously increasing over the last decade. These include metformin, sulfonylureas, thiazolidinediones, incretin-based therapies, sodium-glucose cotransporter 2 inhibitors and different types of insulin. Most T2DM medications effectively reduce glycated hemoglobin, with their efficacy ranging from approximately 0.8% to 1.5% reduction in HbA-1c glycated hemoglobin. In patients where diabetes standard glucose levels are not achieved, long-term complications might appear[36].

Globally, diabetes incurs at least 966 billion dollars in healthcare costs, an increase of 316% over the past 15 years. Official data suggest that the average medical costs for patients diagnosed with diabetes is 2,636 US dollars per year. This translates to a total healthcare expenditure of 980.5 million US dollars in 2021. The International Diabetes Federation projects an increase in healthcare expenditures related to diabetes treatment, estimating an average cost of 2,895 US dollars per year by the year 2030. On average, people with diagnosed diabetes have medical costs approximately 2.3 times higher compared to healthy individuals. Overall, this comment highlights the significant healthcare costs associated with diabetes treatment. In the Republic of North Macedonia approximately 103,420 patients were on non-insulin antidiabetic treatment and 42,000 were on insulin therapy in 2021. The percentage from total number of prescriptions for blood glucose lowering drugs (excluding insulin) in our country rose from 7.3% in 2018 up to 7.6% in 2020. Unfortunately, these are the only publicly available data for the drugs that are covered by health incurrence, and there is a lack of information for out-of-pocket expenditures for patients on antidiabetic, non-insulin treatment in the Republic of North Macedonia. Additionally, the cost of provision of

diabetes treatment supplies in 2021, for patients on insulin amounted to 759,655,000.00 denars, which is approximately 13,457,508,62 USD. Presented data refer to all direct cost associated with diabetes, but when complications associated with diabetes are taken into account the economic burden dramatically increases. According to the latest data from the World Health Organization (WHO), diabetes and its complications account for 3.42% of the total burden of all diseases and conditions worldwide. As presented in the results, the calculated burden of diabetes mellitus and diabetic complications in the Republic of North Macedonia amounts to 42,806.59 DALYs. Overall, this piece of information underscores the significant impact of diabetes and its complications on public health, both globally and specifically within North Macedonia, with a focus on the loss of healthy life years and the most affected age groups. Percentage change in age-standardized DALY rate in 1990-2021(%) in North Macedonia was 46.4%, with the highest value compared to global range (38.6%). Compared to neighboring countries, North Macedonia has the highest percentage of DALY from diabetes mellitus, followed by Albania (26.9%), Croatia (29.7%), Romania (18%), Central Europe (23.0%), but excluding Bosna and Hercegovina (88.3%), with the highest rate in Europe[37].

Conclusions

Diabetes is a serious medical condition that affects millions of people worldwide. In line with the global trends, the incidence and prevalence rates of diabetes in the Republic of North Macedonia increased in the evaluated period, 2018-2021. The results obtained in this study confirmed that 7.09% of the population in North Macedonia in 2021 were living with diabetes. The incidence rate of T1DM inclined from 1.21%ooo in 2018 to 2.8%ooo in 2021, while the incidence rate for T2DM raised from 323.3%ooo to 355.5%ooo in the evaluated period. The same trend was confirmed for the prevalence rate of T2DM presented with 5554.4%ooo in 2018 and 6549.3%ooo in 2021. The calculated burden of diabetes mellitus and its complications in the Republic of North Macedonia is 42,806.59 DALYs, where 20,671.47 are due to years of life lost (YLLs) and 22,135.12 are due to years lived with disability (YLDs) caused by diabetes and diabetic complications, resulting in higher costs. This epidemiological study is a solid base for implementation of the national strategy for diabetes and will contribute in effective planning and evaluation of all aspects of diabetes control in the Republic of North Macedonia.

References

1. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. Diabetes Care. 2014 Jan 1;37(Suppl 1):S81-S90. DOI: 10.2337/dc14-S081.
2. World Health Organization. Global Report on Diabetes; WHO: Geneva, Switzerland, 2017.
3. Report of a WHO Consultation. Geneva, Switzerland: World Health Organization; 1999.

4. American Diabetes Association. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes—2021. Diabetes Care. 2021;44(Suppl. 1): S15-S33. DOI: 10.2337/dc21-ad09.

5. Donath MY, Meier DT, Böni-Schnetzler M. Inflammation in the pathophysiology and therapy of cardiometabolic disease. Endocrine Reviews 2019; 40(4): 1080-1091. DOI: 10.1210/er.2019-00002.

6. The Effect of Insulin on the Alpha-Cell Response to Hyperglycaemia in long-standing alloxan diabetes. PMC333086.

7. Hu FB, Manson JE, Stampfer MJ, et al. Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. N Engl J Med. 2001; 345:790–797.

8. Guilherme A, Virbasius JV, Puri V, Czech MP. Adipocyte dysfunctions linking obesity to insulin resistance and type 2 diabetes. Nat Rev Mol Cell Biol 2008; 9(5):367-77. DOI: 10.1038/nrm2391.

9. Weyer C, Bogardus C, Mott DM, Pratley RE. The natural history of insulin secretary dysfunction and insulin resistance in the pathogenesis of type 2 diabetes mellitus. The Journal of Clinical Investigation 1999; 104: 787-794. DOI: 10.1172/JCI7231.

10. Spellman CW. Pathophysiology of type 2 diabetes: targeting islet cell dysfunction. J Am Osteopath Assoc 2010;110(3 Suppl 2):S2-7. PMID: 20382838.

11. Lopez J. Carl A. Burtis, Edward R. Ashwood and David E. Bruns (eds): Tietz Textbook of Clinical Chemistry and Molecular Diagnosis (5th edition): Elsevier, St. Louis, USA, 2012, 2238 pp, 909 illustrations. Indian J Clin Biochem. 2013 Jan;28(1):104–5. DOI: 10.1007/s12291-012-0287-7. PMCID: PMC3547451.

12. The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus: Committee Report 2001, American Diabetes Association.

13. Centers for Disease Control and Prevention. National Diabetes Statistics Report. Accessed in 12.06.2022.

14. Zimmet P, Alberti KG, Shaw J. Global and societal implications of the diabetes epidemic. Nature 2001; 414:782–787.

15. Scott A, Chambers D, Goyder E, O'Cathain A. Socioeconomic inequalities in mortality, morbidity and diabetes management for adults with type 1 diabetes: a systematic review. PLoS One. 2017;12 (5): e0177210. DOI: 10.1371/journal.pone.0177210.

16. Mazidi M, Toth P P, Banach M. C-reactive protein is associated with prevalence of the metabolic syndrome, hypertension, and diabetes mellitus in US adults. Angiology. 2017;(article 331971772928). DOI: 10.1177/0003319717729288.

17. Alberti KG, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. Diabet Med. 1998 Jul;15(7):539-

53. DOI: 10.1002/(SICI)1096-9136(199807)15:7<539:AID-DIA668>3.0.CO;2-S.

18. Deshpande A D, Harris-Hayes M, Schootman M. Epidemiology of diabetes and diabetes-related complications. Physical Therapy 2008; 88(11):1254–1264. DOI: 10.2522/ptj.20080020.

19. Tuttolomondo A, Maida C, Pinto A. Diabetic foot syndrome as a possible cardiovascular marker in diabetic patients. Journal of Diabetes Research. 2015; 2015:12. DOI: 10.1155/2015/268390.

20. Lee ET, Keen H, Bennett PH, Fuller JH, Lu M. Follow-up of the WHO Multinational Study of Vascular Disease in Diabetes: general description and morbidity. Diabetologia. 2001;44(Suppl 2(2)):S3–13. DOI: 10.1007/PL00002936.

21. LeRoith D, Fonseca V, Vinik A. Metabolic memory in diabetes--focus on insulin. Diabetes Metab Res Rev. 2005;21(2):85–90. DOI: 10.1002/dmrr.530.

22. Solli O, Stavem K, Sonbo Kristiansen I. Health-related quality of life in diabetes: The associations of complications with EQ-5D scores. Health and Quality of Life Outcomes. 2010;8(1):18. DOI: 10.1186/1477-7525-8-18.

23. Linda SG, William HH, Smith PJ. National Diabetes Data Group. Diabetes in America. Bethesda. 2. 1995. Mortality in Non-Insulin-Dependent Diabetes[A] NIH Publication NO.9521468.

24. International Diabetes Federation. Diabetes Atlas. 2. Brussels.

25. Available at https://fzo.org.mk/. Accessed in 10.11.2022.

26. International Diabetes Federation. Available at: https://idf.org/aboutdiabetes/what-is-diabetes/facts-figures.html.

27. Deshpande A D, Harris-Hayes M, Schootman M. Epidemiology of diabetes and diabetes-related complications. Physical Therapy 2008; 88(11):1254–1264. DOI: 10.2522/ptj.20080020.

28. American Diabetes Association. Economic costs of diabetes in the U.S. in 2007. Diabetes Care 2008; 31:596–615.

29. Chen L, Magliano DJ, Zimmet PZ. The worldwide epidemiology of type 2 diabetes mellitus-present and future perspectives. Nat Rev Endocrinol 2012;8(4):228–36.

30. Source: RSM Government. 2020 program to provide insulin, glucagon, insulin needles, sugar test strips and diabetes treatment and control education. Skopje: 2020.

31. Available at https://fzo.org.mk/izvestai-potrosuvacka-lekovi-pzz. Accessed in 13.10.2023.

32. Afroz A, Alramadan MJ, Hossain MN. et al. Cost-of-illness of type 2 diabetes mellitus in low and lower-middle income countries: a systematic review. BMC Health Serv Res 2018; 18: 972. DOI: 10.1186/s12913-018-3772-8.

33. International Diabetes Federation. International Diabetes Atlas. Available at https://diabetesatlas.org/.

34. American Diabetes Association. The cost of Diabetes. Available

at: https://diabetes.org/about-us/statistics/cost-diabetes.

35. www.iph.mk. Accessed in 12.12.2022.

36. Mata-Cases M, Benito-Badorrey B, Roura-Olmeda P, Franch-Nadal J, Pepió-Vilaubí JM, Saez M, Coll-de-Tuero G, GEDAPS (Primary Care Group for the study of Diabetes) of the Catalonian Society of Family and Community Medicine. Clinical inertia in the treatment of hyperglycemia in type 2 diabetes patients in primary care. Curr Med Res Opin 2013; 29:1495–502.

37. "Global Burden of Disease Study 2019 (GBD 2019) Covariates 1980-2019." 03 Mar.2023, https://ghdx.h

PUBLIC HEALTH

LIFE HABITS AND SATISFACTION WITH HEALTH SERVICES BY THE ELDERLY IN THE REPUBLIC OF NORTH MACEDONIA

Jansun Bukovetz[1], Elena Kjosevska[1], Shaban Memeti[1], Vesna Velikj-Stefanovska[2], Stojan Gjoshev[3]

[1] *Institute of the Public Health of the Republic of North Macedonia; Ss. Cyril and Methodius University in Skopje, Faculty of Medicine, Republic of North Macedonia*

[2] *Institute of Epidemiology and Biostatistics with Medical Informatics Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia*

[3] *University Clinic for Digestive Surgery, Skopje, Republic of North Macedonia*

Citation: Bukovetz J, Kjosevska E, Memeti Sh, Velikj-Stefanovska V, Gjoshev S. Life habits and satisfaction with health services by the elderly in the Republic of North Macedonia. Arch Pub Health 2024; 16 (1). 21:37.

doi.org/10.3889/aph.2024.6114

Key words: older adults, life habits, aging, North Macedonia

***Correspondence:** Jansun Bukovetz, Institute of the Public Health of the Republic of North Macedonia, Skopje, Republic of North Macedonia.

E-mail: cansun-97@hotmail.com

Received: 5-Jan-2024; **Revised:** 28-Mar-2024; **Accepted:** 3-Apr-2024; **Published:** 01-Jul-2024

Copyright:© 2024. Jansun Bukovetz, Elena Kjosevska, Shaban Memeti, Vesna Velikj Stefanovska, Stojan Gjoshev. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

Competing Interests: The author have declared that no competing interests

Abstract

The aging of the population in North Macedonia is a big challenge. Life habits and satisfaction with health services are essential indicators for the evaluation of the situation. Objectives: The main objective of this study was to analyze some lifestyle habits and satisfaction with health services by the elderly in North Macedonia. Materials and Methods: A cross-sectional study was conducted in 36 urban areas. We received answers from 281 respondents over 65 years of age. The descriptive-statistical method was used for analyzing the results. Statistical analysis of data was done with the statistical software SPSS for Windows 26.0. The testing of the differences was done with the Chi-square test, Mann-Whitney U Test, Kruskal-Wallis test, Fisher Freeman Halton test and Spearman Rank order correlations. Values of $p<0.05$ were considered to be statistically significant. Results: There were 52 (18.05%) smokers, 22 (21.15%) were male and 30 (16.95%) female respondents. The average number of cigarettes smoked per day was 20.90±15.50 with no significant difference between genders and the three age categories. Most of the respondents had a visit to the family doctor for continuation of their therapy. No significant association was observed between respondents' gender/age category in terms of trust in the family doctor, adherence to the doctor's advice, and life satisfaction. Conclusion: The relevant authorities in our country should develop more comprehensive and social models of care for older adults, especially in rural areas such as prevention, long-term care, and palliative care.

ЈАВНО ЗДРАВЈЕ

ЖИВОТНИ НАВИКИ И ЗАДОВОЛНОСТ ОД ЗДРАВСТВЕНИТЕ УСЛУГИ НА СТАРИТЕ ЛИЦА ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА

Џансун Буковец[1], Елена Ќосевска[1], Шабан Мемети[1], Весна Велиќ Стефановска[2], Стојан Ѓошев[3]

[1] *Институт за јавно здравје на Република Северна Македонија; Универзитет Св. Кирил и Методиј во Скопје, Медицински факултет, Република Северна Македонија*

[2] *Институт за епидемиологија со биостатистика и медицинска информатика, Универзитет Св. Кирил и Методиј во Скопје, Медицински факултет, Република Северна Македонија*

[3] *Универзитетска клиника за дигестивна хирургија, Скопје, Република Северна Македонија*

Цитирање: Буковец Џ, Ќосевска Е, Мемети Ш, Стефановска Велиќ В, Ѓошев С. Животни навики и задоволност од здравствените услуги на старите лица во Република Северна Македонија. Арх Ј Здравје 2024;16 (1) 21:37.

doi.org/10.3889/aph.2022.6114

Клучни зборови: постари возрасни лица, животни навики, стареење, Северна Македонија

***Кореспонденција:** Џансун Буковец, Институт за јавно здравје на Република Северна Македонија, Северна Македонија.

E-mail: cansun-97@hotmail.com

Примено:5-јан-2024; **Ревидирано:**28-мар-2024; **Прифатено:** 3-апр-2024; **Објавено:** 01-јули-2024

Печатарски права: ©2024. Џансун Буковец, Елена Косевска, Шабан Мемети, Весна Велиќ Стефановска, Стојан Ѓошев. Оваа статија е со отворен пристап дистрибуирана под условите на нелокализирана лиценца, која овозможува неограничена употреба, дистрибуција и репродукција на било кој медиум, доколку се цитираат оригиналниот(ите) автор(и) и изворот.

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Извадок

Стареењето на населението во Северна Македонија е голем предизвик. Животните навики и задоволството од здравствените услуги се суштински показатели за процена на состојбата. Главната цел на оваа студија беше да се анализираат некои животни навики и задоволството од здравствените услуги кај постарите лица во Северна Македонија. Материјали и методи: Спроведена е студија на пресек во 36 урбани средини. Одговори добивме од 281 испитаник над 65 години. За анализа на резултатите се користеше дескриптивна статистичка метода. Статистичката анализа на податоците е направена со статистичкиот софтвер SPSS за Windows 26.0. Тестирањето на разликите беше направено со Chi-square тест, Mann-Whitney U Test, Kruskal-Wallis тест, Fisher Freeman Halton тест и Spearman Rank корелации за редослед. Вредностите од $p<0,05$ се сметаа за статистички значајни. Резултати: Имаше 52 (18,05%) пушачи, 22 (21,15%) беа мажи и 30 (16,95%) жени. Просечниот број на испушени цигари дневно изнесува 20,90±15,50 без значајна разлика меѓу полот и трите возрасни категории. Најголем дел од испитаниците имале посета на матичен лекар за продолжување на терапијата. Не е забележана значајна поврзаност помеѓу полот/возрасната категорија на испитаниците во однос на довербата во матичниот лекар, почитувањето на советите од лекарот и задоволството од животот. Заклучок: Одговорните во нашата земја треба да развијат посеопфатни и социјални модели на грижа за постарите возрасни лица, особено во руралните области како што се превенција, долготрајна нега и палијативна нега.

Introduction

The elderly are a heterogeneous group with many variations in biological characteristics, individual lifestyles, and capabilities. Population aging causes demographic, epidemiological, and anthropological changes highlighting the importance of active and healthy aging.

A precise analysis of the elderly'shealth status cannot be performed if socio-medical aspects are not analyzed. As a result of better socio-economic and health services, the life expectancy of the population is increasing. But, this increase is already a big challenge for all countries[1]. Life expectancy at birth has increased due to better circumstances of life and medical progress. In countries of today's European Union (EU)-27, a newborn girl can expect to live 83,2 years, boys about 77,5 years, 5,7 years longer than a male newborn[2]. The ratio of older adults is increasing while that of working age population is decreasing. If current trends prevail until 2050, a person of working age might have to provide, on average, for twice as many retired people than today. In most EU countries, old age and survivor benefits make up the largest item of social protection expenditure (EU-wide, it amounted to 45.9% of total benefits in 2005)[3]. In the Republic of North Macedonia, 13.6% of the population is older than 65 years. When we analyze the structure of social protection expenditure in the EU, we can notice that old age and sickness/healthcare benefits – together account for 66.9% of total expenditure. In 2019, expenditure on all types of social protection in the EU was equivalent to 28.1% of Gross Domestic Product (GDP). In the Republic of North Macedonia (MKD), social expenditure for 2019 was 14.5% of GDP[4]. According to data from the Ministry of Labour and Social Policy of the Republic of North Macedonia in 2022, the total number of retired personswas 228.364, these numbers increased to 333.322 with other groups of pension beneficiaries[5]. MKD is an upper middle-income country that has a huge healthcare infrastructural deficit;moreover, 12.1% of older adults lived alone in 2018 in MKD, and this trend is rising[6]. The extended family support system has dwindled over the years due to rural-urban migration and migration abroad. Family structures are changing, and the health and social systems have limited capacity to provide integrated and person-centered care, leaving older people in the country facing many health, social and economic issues. The challenge is bigger in developing countries such as MKD, and it is debatable whether the health system is ready to face such a burden for older adults. Faced with this kind of challenge, some countries have developed and promoted "individualized care plans". By using individualized care plans, room visits and hospitalization scan be reduced, and it can also help in retaining the quality of life and independence of the care recipient. Center for Diseases Control (CDC) has already created a Complete Care Plan (CCP)[7]. Investing in healthy aging is crucial for sustainable healthcare and social policy. To tackle the health and social challenges of the aging population, the Ministry of Labour and Social Policy of RN Macedonia adopted the National Strategy for Elderly People 2010–2020 and the Action Plan for

Healthy Ageing 2020. The Ministry of Health introduced several initiatives to provide greater access to health services for older people, such as home visits by community nurses (also called patronage nurses), the Rural Doctors Project[8], and mobile pharmacies, as well as introduction of pilot integrated health and social services[9].

The main objective of this study was to analyze some lifestyle habits and satisfaction with health services by the elderly in the Republic of North Macedonia.

Materials and methods

This cross-sectional study was conducted in 36 urban areas (municipalities) and ten villages between September 2020 and April 2021. The selection of respondents was made by applying a simple random sampling method. The study was conducted during the period of COVID-19 pandemic. Many people were socially isolated. The findings provided some insights about older adults in MKD, but 281 is not a representative number for MKD. A questionnaire was developed by the authors; it consisted of 49 questions and was distributed among respondents. Forty-two were multiple-choice answers with the option to choose one or several answers. The other seven questions were short answer questions. All respondents were informed about the aim of the study and they signed an informed consent. The questionnaire was written in their mother tongue, the Macedonian language. The questionnaire was pretested by five people. Questions were formulated in such a way as to give us an insight into the older adult's habits, and health condition and to assess their independence level during daily activities. We received answers from 281 respondents over the age of 65 years. Seventy questionnaires were completed through the method of physical observation of the interviewer. The other 211 were via Google Forms. The questionnaire was divided into four parts: the first part - general and demographic characteristics; the second part – life habits; the third part - satisfaction with the health services of the state and the fourth part - health condition and daily implications of various life activities. The descriptive-statistical method was used for analyzing the results. Although there are different ways to classify older adults, we decided to use the following classification: older adults between the ages of 65 and 74 years as youngest-old, those between ages 75 and 84 years as middle-old, and those aged over 85 years as oldest-old.Statistical analysis of data was done with the statistical software SPSS for Windows 26,0. The data are shown with absolute and statistical numbers. The testing was done with the Chi-square test, Mann-Whitney U Test, Kruskal-Wallis test, Fisher Freeman Halton test and Spearman Rank order correlations. Values of $p<0.05$ were considered to be statistically significant.

Results

The study included a total of 281 respondents, 177 (62.99%) females and 104 (37.01%) males, with a gender ratio of 1.7:1 and a significantly higher percentage representation of the female gender (Difference test: 25.98% [(17.79-33.66) CI 95%]; Chi-square=37.865; df=1; p=0.0001).

There were 245 (87.19%) respondents living in urban and 36 (12.81%) living in rural areas. There were 157 (55.87%) Macedonians, 36 (12.81%) Albanians, and from other nationalities - 88 (31.32%). Sixty-eight (24.55%) respondents had no education, 81 (28.82%) had primary education,70 (24.91%) secondary education, and 61 (21.71%) had higher education; men had a significantly higher educational level (Pearson Chi-square test=16.132; df=3; p=0.0011). The analysis according to marital status showed146 (51.96%) married respondents, 4 (1.42%) single, and 131 (46.62%) widowers with significantly more widows among female respondents (Fisher Freeman Halton exact test: p=0.00001). Regarding who they live with, 58 (20.64%) stated that they lived alone, 69 (24.55%) with a spouse/partner, 138 (49.11%) with children/grandchildren/relatives, and 16 (5.69%) in a nursing home. Living with a spouse, partner, or extended family was significantly more associated with male gender (Fisher Freeman Halton test: p=0.00002).

According to the inclusion criteria, the average age in the entire sample of respondents was 74.53±6.68 with a min/max age of 65/98 years and Median IQR = 73 (69-80). The age of men and women was respectively 74.55±6.80 vs. 74.52±6.62, with no significant difference between the genders (Mann-Whitney U Test: Z=0.0554; p=0.9557). Most of the respondents 158 (56.23%) were in the age category of early old age (65-74 years), 97 (34.52%) in the category of advanced old age (75-84 years), and 26 (9.25%) in old age (≥85 years).

There were 52 (18.05%) smokers, 22 (21.15%) male respondents and 30 (16.95%) female respondents, without a significant association of smoking status with the respondents' gender (Pearson Chi-square test=0.7679; df=1; p=0.3808). The average number of cigarettes smoked per day was 20.90±15.50 with no significant difference between genders (Mann-Whitney U Test: Z=-1.306; p=0.1915) and the three age categories (Kruskal-Wallis test:H(2) =0.8681; p=0.6479).

Forty-one (14.59%) respondents declared that they consumed alcohol, 27 (25.96%) were men and 14 (7.91%) women with a significant association of consumption with male gender (Pearson Chi-square test= 17.1303; df=1; p=0.00003). The most common alcoholic beverages consumed were wine, brandy, and beer. The average amount of alcohol consumed per day was 199.85±183.38ml with marginally insignificant consumption of a higher daily amount of alcohol by male subjects (Mann-Whitney U Test: Z=-1.8283; p=0.0675). The dominant frequency of alcohol consumption is every day represented by 22 (53.66%) of the consumers. The age category of respondents in early old age consumed a significantly higher amount of alcohol per day compared to the other two age categories (Kruskal-Wallis test: H(2)=6.8476; p=0.0326).

None of male and 5 (2.82%) female respondents rated their health status as very bad (Table 1 and Table 2). Better health condition was significantly associated with male gender (p=0.000001), and borderline insignificantly associated with the age category of respondents with early old age (p=0.0619).

The average number of annual visits to the family doctor by males and females respectively was 9.37±6.82 vs. 11.22±8.90 with a min/max of

0/48 visits, and no significant difference between genders was found (Mann-Whitney U Test: Z=1.3379; p=0.1809). Among the respondents in early, advanced and old age, the average number of annual visits to the family doctor was 10.48±8.34 vs. 10.43±7.60 vs. 11.31±9.91 with no significant difference between the three age categories (Kruskal-Wallis test: H(2)=0.0389; p=0.9807).

During one year, the average number of visits to a specialist among male and female respondents was respectively4.49±4.52 with min/max 0/24 vs. 5.40±5.15 with min/max 0/28 visits, with no significant difference between genders (Mann-Whitney U Test: Z=1.2689; p=0.2045). Among the three age categories of respondents, there was no significant difference in the average annual number of visits to a specialist, which was 4.92±4.62 in early, 5.39±5.23 in severe, and 4.71±5.77 in old age (Kruskal-Wallis test: H(2)=0.3086; p=0.8570).

The analysis of health status and satisfaction with health services is given in Table 1 and Table 2. None of the respondents of both genders stated that the reason for visiting a family doctor was a request for a referral to a specialist. Most of the respondents had a visit to the family doctor for continuation of their therapy. No significant association was observed between respondents' gender/age category in terms of trust in the family doctor, adherence to the doctor's advice, and life satisfaction.

Table 1 Analysis of health status parameters by gender

Parameters	Gender		p
	Male	Female	
Health condition			
Good	56 (53.85%)	39 (22.03%)	X^2=28.38; df=2; p=0.000001*
Relatively good	41 (39.42%)	107 (60.45%)	
Bad	7 (6.73%)	26 (14.69%)	
Very bad	0 (0%)	5 (2.82%)	-
Flu vaccine every season			
Yes	29 (27.88%)	48 (21.12%)	X^2=0.019; df=1; p=0.8894
No	75 (71.12%)	129 (72.88%)	
Reason for visiting family doctor			
Continuation of therapy	67 (64.42%)	126 (71.19%)	X^2=1.393; df=1; p=0.2379
Acute illness check-up	32 (30.77%)	55 (31.07%)	X^2=0.003; df=1; p=0.9575
A visit to a doctor by personal request	28 (26.92%)	45 (25.42%)	X^2=0.076; df=1; p=0.7819
Request for specialist examination	-	-	-
Confidence in a family doctor			
Great confidence and very satisfied	82 (78.85%)	131 (74.01%)	X^2=1.927; df=2; p=0.3815
Partial trust and not very satisfied	21 (20.19%)	40 (22.60%)	
I have no confidence and I am not satisfied at all	1 (0.96%)	6 (3.39%)	

Adherence to doctor's advice			
Yes. always without exception	70 (67.31%)	125 (70.62%)	X^2=0.528; df=2; p=0.7678
Sometimes yes. sometimes no	29 (27.88%)	46 (25.99%)	
I rarely follow the advices	5 (4.81')	6 (3.39%)	
Never	-	-	-
Has a chronic illness			
Yes	89 (85.58%)	156 (88.14%)	X^2=0.3839; df=1; p=0.5355
No	15 (14.42%)	21 (11.86%)	
Has a malignant disease			
Yes	5 (4.81%)	3 (1.69%)	X^2=2.2948; df=1; p=0.1298
No	99 (95.19%)	174 (98.31%)	
Are you satisfied with life?			
Yes. a lot	41 (39.42%)	59 (33.33%)	[1]p=0.1013
Yes	49 (47.12%)	73 (41.24%)	
Partially	11 (10.58%)	30 (16.95%)	
No	3 (2.88%)	15 (8.47%)	
[1]Fisher Freeman Halton test;	Pearson Chi-square test=X^2; for p<0.05		*significant

Table 2 Analysis of health status parameters according to age categories

Parameters	Age categories			p
	Young old	Middle old	Very old	
Health condition				
Good	52 (32.91%)	21 (21.65%)	7 (26.92%)	[1]p=0.0619
Relatively good	91 (57.59%)	59 (60.82%)	13 (50%)	
Bad	14 (8.86%)	15 (15.46%)	4 (15.38%	
Very bad	1 (0.63%)	2 (2.06%)	2 (7.69%	
Flu vaccine every season				
Yes	41(25.95%)	27 (27.84%)	9 (34.62%)	X^2=0.857; df=2; p=0.6515
No	117 (74.05%)	70 (72.16%)	17 (65.38%)	
Reason for visiting family doctor				
Continuation of therapy	106 (67.09%)	72 (74.23%)	15 (57.69%)	X^2=3.0329; df=2; p=0.2194
Acute illness check-up	44 (27.85%)	30 (30.93%)	13 (50%)	X^2=5.125; df=2; p=0.0771
A visit to a doctor by personal request	41 (25.96%)	25 (25.77%)	7 (26.92%)	X^2=0.014; df=2; p=0.9929
Request forspecialist examination	-	-	-	-

Confidence in a family doctor				
Great confidence and very satisfied	123 (77.85%)	69 (71.13%)	21 (80.77%)	X^2=3.789; df=2; p=0.1504
Partial trust and not very satisfied	28 (17.72%)	28 (28.87%)	5 (19.23%)	
I have no confidence and I am not satisfied at all	7 (4.43%)	0 (0%)	0 (0%)	-
Adherence to doctor's advice				
Yes, always without exception	107 (67.72%)	69 (71.13%)	19 (73.08%)	X^2=0.628; df=4; p=0.9598
Sometimes yes, sometimes no	45 (28.48%)	24 (24.74%)	6 (23.08%)	
I rarely follow the advices	6 (3.80%)	4 (4.12%)	1 (3.85%)	
Never	-	-	-	-
Has a chronic illness				
Yes	135 (85.44%)	86 (88.66%)	24 (92.31%)	X^2=1.2289; df=2; p=0.5409
No	23 (14.56%)	11 (11.34%)	2 (7.69%)	
Has a malignant disease				
Yes	4 (2.53%)	2 (2.06%)	2 (7.69%)	X^2=2.4799; df=2; p=0.2894
No	154 (97.47%)	95 (97.94%)	24 (92.31%)	
Are you satisfied with life?				
Yes, a lot	56 (35.44%)	33 (34.02%)	11 (42.31%)	[1]p=0.0861
Yes	71 (44.94%)	44 (45.36%)	7 (26.92%)	
Partially	25 (15.82%)	13 (13.40%)	3 (11.54%)	
No	6 (3.80%)	7 (7.22%)	5 (19.23%)	
[1]Fisher Freeman Halton test;			Pearson Chi-square test;	
*significant for p<0.05				

Table 3 Non-parametric correlation between selected parameters

Parameters	Spearman Rank order corellations			
	Gender	Age	Education	Adherence to doctor's advice
Confidence in a family doctor	R (281)=0.059; p=0.319	R (281)=0.009; p=0.868	R (281)=-0.025; p=0.673	R (281)=0.230; p=0.0001*
	Gender	Age	Chronic illness	Malignant disease
Life satisfaction	R (281)=0.116; p=0.052	R (281)=0.047; p=0.436	R (281)=0.150; p=0.012*	R (281)=0.015; p=0.802
	Gender	Age	Nationality	Level of education
Adherence to doctor's advice	R (281)=-0.038; p=0.529	R (281)=0.022; p=0.708	R (281)=-0.003; p=0.965	R (281)=-0.061; p=0.309
*significant for p<0.05				

A significant linear positive weak correlation was observed between trust in the family doctor and adherence to the doctor's advice (Spearman Rank order correlations: R (281)=0.230; p=0.0001) – as trust in the family doctor grows, so does adherence to the advice. A significant linear positive weak correlation was also found between life satisfaction and chronic disease (Spearman Rank order correlations: R(281)=0.150; p=0.012) as well as between life satisfaction and chronic disease – life satisfaction was higher in patients without chronic diseases (Table 3 and Figures1-3).

Figure 1. Non-parametric correlation between trust in a doctor and selected parameters

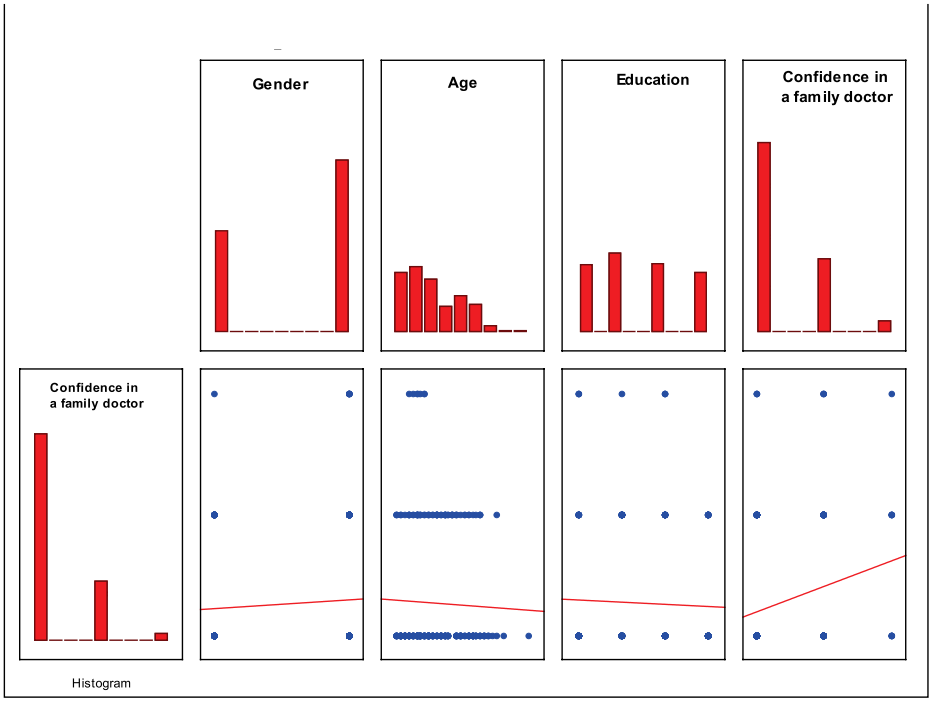


Figure 2. Non-parametric correlation between life satisfaction and selected parameters

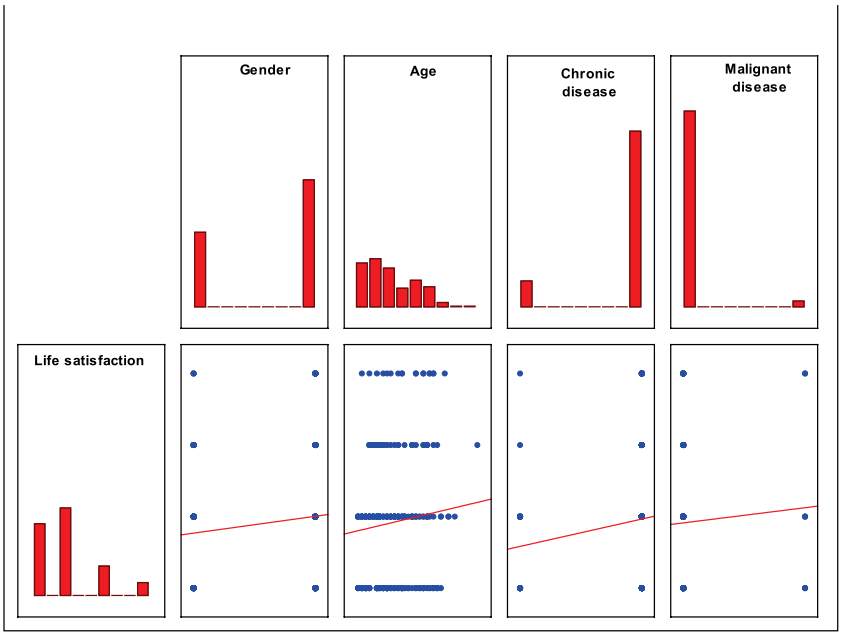
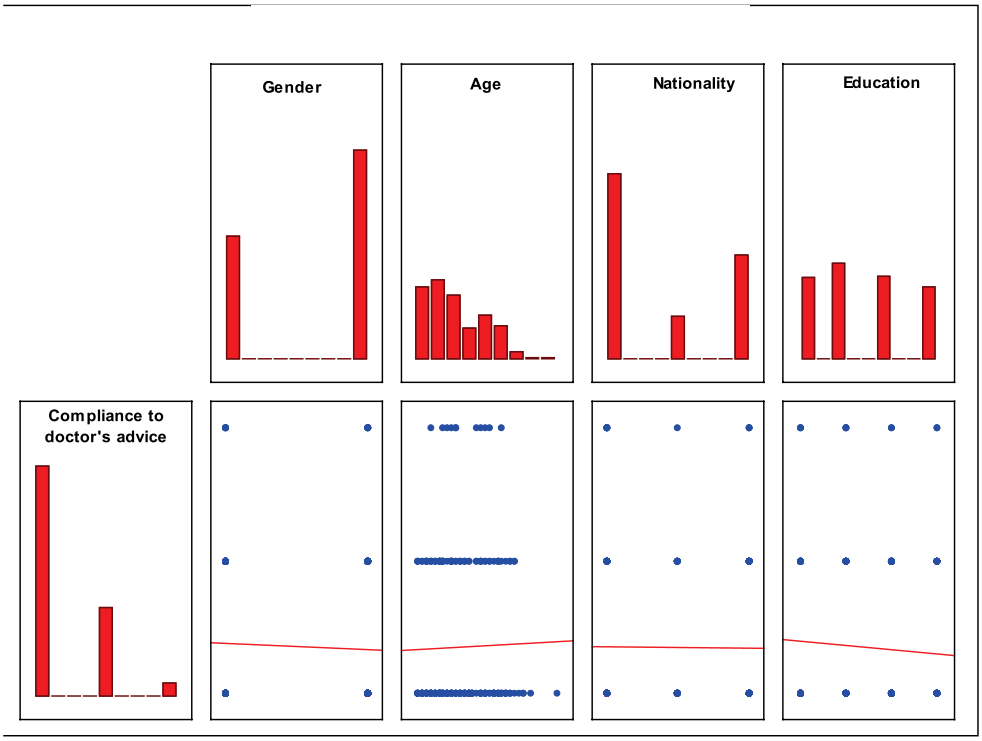


Figure 3. Non-parametric correlation between compliance to doctor's advice and selected parameters



Discussion

The population of North Macedonia is increasingly getting older. Elderly people burden the health system, and cause serious social and economic effects on the individual, family and community. Policy makers are in need of national scientifically-based data[11]. In our study, 24.55%of respondents were without education, 28.22% had primary education, 24.91% secondary education and 21.71% higher level education, with a significantly higher educational level registered among men (Pearson Chi-square test=16.132; df=3; p=0.0011), and these numbers are comparable with the educational level of women (34.5%) and men (43.4%) in a Spanish study[12].Being married increases life satisfaction among older adults[13]. Death of a spouse or partner is one of the most devastating events in the life of a person and seriously affects life satisfaction[14]. Widowhood has a negative impact on well-being and mental health. Although it is characteristic for both men and women, the prevalence of mental disorders such as anxiety and depressive disorders is prevailing in men[15]. Perhaps fortunately, widowhood is common among older women, over 50% of women over the age of 70 have ever been widowed[16], similarly as in our respondents – 47.04% of single and widowers were females (Fisher Freeman Halton exact test: p=0.00001).Living with a spouse, partner or extended family was significantly more associated with male gender (Fisher Freeman Halton test: p=0.00002). A cross-sectional survey conducted among Korean individuals aged 65 and over (n =14,687) revealed a significant difference in the happiness index among older adults living alone (6.22 ± 2.11), older adults living with their spouse (6.76 ± 1.99), and older adults living with their family (6.46 ± 1.94). Rais-

ing happiness index of elderly adults depends on circumstances and living arrangements[17].

Similar to this, most of the elderly participants in Li's study were married and lived with their spouse (42%) or friends (33%) and such supportive environments for elderly patients led to increase in life satisfaction[18].

Five percent of Kosovars, 20% of Serbians[19], 25% of Turks[20], 27.4% of Albanians[19], and 27.43% of elderly Macedonian citizens were living alone. However, in our survey this percent was 20.64. According to the World Economic and Social Survey for 2007, 35% of people over the age of 60 years lived alone, while in underdeveloped countries 7% of the elderly lived alone. Tradition, low economic standard are important factors for living alone in elderly people. Living alone has risen and is expected to increase[21]. However, living alone tend to be socially isolated[22], have poor health status[23], lower life satisfaction, and self-esteem[24].

Alcohol consumption starts in adolescence and decreases in the older age, though it is not recognized[25]. Alcohol use disorders affect 1-3% of older adults[26]. According to the American Dietary Guidelines[27], limitation for adults is two drinks or less per day for men and one drink or less per day for women. Breslow *et al.* pointed out that alcohol drinking had an upward trend among adults aged over 60, particularly women[28]. Although alcohol abuse is underreported[29], the effects of alcohol can be more quickly expressed in older adults. It increases the risks of falls, car crashes, and bad interactions with medications[30]. Alcohol consumption among women in our study was significantly lower than in the study of Breslow The Substance Abuse and Mental Health Services Administration (SAMHSA), which conducts annual National Survey on Drug Use and Health (NSDUH), defines binge drinking as 5 or more alcoholic drinks for males or 4 or more alcoholic drinks for females on the same occasion (i.e., at the same time or within a couple of hours of each other) on at least 1 day in the past month31. 53.66% of the consumers said that they consume alcohol every day. Mirand and Welte reported that 62% of respondents drank alcohol contrary to 14.59% of our respondents[32].

Older people also contribute in many ways to their families and communities. Yet, the extent of these opportunities and contributions depend heavily on one factor: health[33].

Smoking rates between 1965 and 1994 were reduced by 5.9%[34]. Smoking prevalence among older adults in 17 European countries was 11.5% (15.3% in men and 8.6% in women)[35]. It was 8.3%in the United States. In the United Kingdom, the lowest percentage (8%) of current smokers among people over 65 years was found compared to other age groups[36]. Smoking prevalence was highest in eastern/central Europe for men (20.3%) and northern Europe for women (13.1%). In both genderscombined, smokers were more frequent in countries with low implementation of tobacco control activities (14.9%)35. In Australia, people in their 60s smoked 16.5 cigarettes per day and in their 70s over

15.5 cigarettes per day. In our study, the average number of smoked cigarettes was 20.90±15.50 and was higher than in Australians of the same age[37].

There are no specific data about smoking percentages and patterns of smoking among older adults in MKD. 48.4% of Macedonians are smokers and they smoke on average twenty cigarettes daily[38];18.05% of our respondents were smokers. Regardless of age, quitting smoking can increase life expectancy and improve health and quality of life.

Patients' trust to their GP/family medicine doctor is associated with improved health outcomes, including patients' adherence totreatment advice, and satisfaction with health care[39],[40]. It can be expected that older adults need more frequent visits to consult both general practitioners (GPs) GPs/family medicine doctors, and specialists. In 2018 in MKD, although older people represented 13.9% of the total population, they accounted for around 22% of the total GP/family medicine doctor visits, 13% of visits to dentists, and 6.7% of gynecological visits. On average, there were 10.13 GP/family medicine doctor consultations per older person per year6.In Canada, seniors visited their family physicians 10 times a year or more compared toadults (9.7% vs. 5.5%)[41]. These numbers are in correlation with our percentages, 9.37±6.82 vs. 11.22±8.90 min/max respectively for women and men. According to the World Health Organization (WHO) Report "Older people and access to health care in North Macedonia", older people aged 75–84 years visit GP/family medicine, and gynecologist but in our study, we did not find a significant difference between elderly age categories. Older people in North Macedonia were less likely to consult a specialist compared to a GP/family medicine doctor. Male patients more often had consultations with a specialist than female patients. In addition, patients aged 85 years and over more often were referred to specialist consultations than those aged 65 to 84[6].

Studies have reported that older men have significantly better health status than older women[6,42,43,] which is in agreement with our results (p=0.000001). According to a Brazilian survey comprising 1,000 participants44, prevalence of negative self-rated health wasobserved in older adults. But gender did not show a significant difference. In the study by Menget *al*[45], participants' average self-rated health status on a scale from 0 to 100 (0 meaning the worst and 100 meaning the best) was 72.49±15.64. However, there was a borderline non-significant association with the age category of respondents with early old age (p=0.0619) among the three age categories in terms of how they feltabout their health, which wascontrary to Totikj study[42] and results presented in the WHO report[6]. Higher life satisfaction is associated with fewer doctor visits, which may have important implications inreducing health care costs[46].

Beside other variables on life satisfaction, health status, physical health, therate of chronic diseases is very high in older adults[47]. Eighty percent of older adults have at least one chronic disease[42]. 67.5% of the aged population suffered two or

more chronic diseases[48]. In 2014, 60% of Americans had at least one chronic condition, and 42% had multiple chronic conditions[49]. 73.72% of our older adults had at least one chronic illness, and 26.28% had none. Those who experienced chronic diseases, also reported significantly lower perceived life satisfaction and this was particularly true forwomen[50]. In Turkey[51], 27% of patients diagnosed with cancer are over 65 years of age. In the United States of America this percent is more than 60. In our sample this percent is only 6.5. Older adults with chronic illnesses have poor quality of life. Individuals with chronic diseases usually experience a decline in their quality of life. Respondents without any known health problems rated that their life satisfaction 3.16 out of 4. Others with any of the common health problems had lower life satisfaction than 3.16[52]. The overall prevalence of depression among the elderly population in India was 8.7%. Chronically ill women had a greater prevalence rate of depression than older men. The prevalence of depression among older adults with three or more chronic conditions was higher in males (14.5%) than in females (11.2%)53. Also, depression[54], anxiety[55], life satisfaction[56], and subjective well-being[57] were worse among older adults.

Conclusion

The population of North Macedonia is getting increasingly older. Elderly people burden the health system, and cause serious social and economic effects on the individual, family and community. On the other side, older people also contribute in many ways to their families and communities. Yet, the extent of these opportunities and contributions depends heavily on one factor: health. Regardless of age, quitting smoking and drinking alcohol, regular visits to doctors for preventive care services can increase life expectancy and improve health and quality of life. The relevant authorities in our country should develop more comprehensive and social models of care for older adults, especially in rural areas as prevention, long-term care, and palliative care.

References

1. Tulchinsky TH, Varavikova EA. The New Public Health: An Introduction for the 21st-Century.San Diego: Academic Press;2000.
2. Eurostat-Life expectancy higher for women in all EU regions. [Internet]. Brussels: Eurostat;2018 Nov 18 [cited 2023 Feb 01]. Available from: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20221118-1
3. Office for Official Publications of the European Communities. Living conditions in Europe, Rev ed. [Internet]. 2008 [cited 2023 Feb 01] Available from: https://ec.europa.eu/eurostat/documents/3930297/5962390/KS-DZ-08-001-EN.PDF.pdf/c9248f4b-57f8-4314-baad-021d0d87fbf4?t=1415007487000
4. Eurostat Statistics Explained. [Internet]. Brussels: Eurostat; 2022 Jun [cited 2023 Feb 01]. Available from: https://ec.europa.eu/eurostat/

statistics-explained/index.php?title=Social_protection_statistics_-_overview#Recent_developments_in_social_protection_expenditure

5. Ministry of Labor and Social and Social Policy. [Internet]. Skopje: Ministry of Labor and Social Policy; 2022 Dec [cited 2023 Feb 01]. Available from: https://www.mtsp.gov.mk/penzisko-i-invalidsko-osiguruvanje-7555a5dc-e101-4e99-8af7-b9a49883dda4.nspx (only Macedonian)
6. World Health Organization. Older people and access to health care in North Macedonia. [Internet]. 2021 [cited 2023 Feb 01] Available from:https://www.euro.who.int/en/countries/north-macedonia/publications/older-people-and-access-to-health-care-in-north-macedonia-2021
7. Centers for Disease Control and Prevention. Maintaining a Care Plan. [Internet]. Atlanta: Centers for Disease Control and Prevention; 2022 Oct 28 [cited 2023 Feb 01]. Available from: https://www.cdc.gov/aging/publications/features/caregivers-month.html
8. Oeppen J, Vaupel J. Demography. Broken limits to life expectancy. Science 2002;296(5570):1029-31. DOI: 10.1126/science.1069675
9. White paper. Adding more health to life: the road to quality and efficient primary health care in the Republic of Macedonia. Skopje: Ministry of Health of the Republic of North Macedonia; 2019.
10. Alterovitz SS, Mendelsohn GA. Relationship goals of middle-aged, young-old, and old-old internet daters: An analysis of online personal ads. J Aging Stud. 2013 Apr 1;27(2):159-65. DOI: https://doi.org/10.1016/j.jaging.2012.12.006
11. Strategy for Demographic Policies in the Republic of Macedonia, 2015-2024, Government of the Republic of Macedonia; 2014
12. Arpino B, Solé-Auró A. Education inequalities in health among older European men and women: The role of active aging. J Aging Health. 2019 Jan;31(1):185-208. DOI: https://doi.org/10.1177/0898264317726390
13. Celik SS, Celik Y, Hikmet N, Khan MM. Factors affecting life satisfaction of older adults in Turkey. Int J Aging Hum Dev. 2018 Dec;87(4):392-414. DOI: https://doi.org/10.1177/0091415017740677
14. Infurna FJ, Luthar SS. The multidimensional nature of resilience to spousal loss. J Pers Soc Psychol. 2017 Jun;112(6):926. DOI: https://doi.org/10.1037/pspp0000095
15. Kristiansen CB, Kjær JN, Hjorth P, Andersen K, Prina AM. Prevalence of common mental disorders in widowhood: A systematic review and meta-analysis. J Affect Disorde. 2019 Feb 15;245:1016-23. DOI: https://doi.org/10.1016/j.jad.2018.11.088
16. Hahn EA, Cichy KE, Almeida DM, Haley WE. Time use and well-being in older widows: Adaptation and resilience. J Wom-

en Aging. 2011 Apr 19;23(2):149-59. DOI: https://doi.org/10.1080/08952841.2011.561139

17. Hwang EJ, Sim IO. Association of living arrangements with happiness attributes among older adults. BMC Geriatr. 2021 Dec;21:1-4. DOI: https://doi.org/10.1186/s12877-021-02017-z

18. Li H, Chi I, Xu L. Life satisfaction of older Chinese adults living in rural communities. J CrossCult Gerontol. 2013 Jun;28(2):153-65. DOI: https://doi.org/10.1007/s10823-013-9189-2

19. Health and Social Conditions of Older People in Albania: Baseline Data from a National Survey. Public Health Rev. 2010;32(2):549-60. DOI: https://doi.org/10.1007/s10823-013-9189-2

20. Turkish Statistical Institute (TURKSTAT). [Internet]. Ankara: Turkish Statistical Institute; 2021 Mar [cited 2023 Feb 01]. Available from: https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Yaslilar-2020

21. Ryu SI, Cho B, Chang SJ, Ko H, Yi YM, Noh EY, Cho HR, Park YH. Factors related to self-confidence to live alone in community-dwelling older adults: a cross-sectional study. BMC Geriatr. 2021 Dec;21:1-2. DOI: https://doi.org/10.1186/s12877-021-02214-w

22. Ko H, Park YH, Cho B, Lim KC, Chang SJ, Yi YM, Noh EY, Ryu SI. Gender differences in health status, quality of life, and community service needs of older adults living alone. Arch Gerontol Geriatr. 2019 Jul 1;83:239-45. DOI: https://doi.org/10.1016/j.archger.2019.05.009

23. Roh M, Weon S. Living arrangement and life satisfaction of the elderly in South Korea. Social Indicators Research. 2020 Jul 21:1-8. DOI: https://doi.org/10.1007/s11205-020-02443-3

24. Shin SH, Sok SR. A comparison of the factors influencing life satisfaction between Korean older people living with family and living alone. International nursing review. 2012 Jun;59(2):252-8.

DOI: https://doi.org/10.1111/j.1466-7657.2011.00946.x

25. Lal R, Pattanayak RD. Alcohol use among the elderly: Issues and considerations. Journal of Geriatric Mental Health. 2017 Jan 1;4(1):4. DOI: 10.4103/jgmh.jgmh_34_16

26. Caputo F, Vignoli T, Leggio L, Addolorato G, Zoli G, Bernardi M. Alcohol use disorders in the elderly: a brief overview from epidemiology to treatment options. Experimental gerontology. 2012 Jun 1;47(6):411-6. DOI: https://doi.org/10.1016/j.exger.2012.03.019

27. US Department of Agriculture and US Department of Health and Human Services. 2020–2050 Dietary Guidelines for Americansexternal icon. 9th ed. Washington, DC; 2020.

28. Breslow RA, Castle IJ, Chen CM, Graubard BI. Trends in alcohol consumption among older Americans: National Health Interview Surveys, 1997 to

2014. Alcoholism: clinical and experimental research. 2017 May;41(5):976-86.

DOI: https://doi.org/10.1111/acer.13365

29. O'Connor PG, Schottenfeld RS. Patients with alcohol problems. New England Journal of Medicine1998;338(9):592-602. DOI: 10.1056/NEJM199802263380907

30. National Institute on Alcohol Abuse and Alcoholism. Older adults [Internet]. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism; [cited 2023 Feb 01]. Available from: https://www.niaaa.nih.gov/alcohols-effects-health/special-populations-co-occurring-disorders/older-adults#

31. National Institute on Alcohol Abuse and Alcoholism. Older adults [homepage on the Internet]. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism; [cited 2023 Feb 01]. Available from: https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking

32.Mirand AL, Welte JW. Alcohol consumption among the elderly in a general population, Erie County, New York. Am J Public Health 1996;86:978-84.

33. World Health Organization Ageing and Mental Health. [Internet]. Geneva: World Health Organization; 2022 Oct 01 [cited 2023 Feb 01]. Available from: https://www.who.int/news-room/fact-sheets/detail/ageing-and-health

34. Kleykamp BA, Heishman SJ. The older smoker. JAMA 2011; 306(8): 876-7. DOI: 10.1001/jama.2011.1221

35. Lugo A, La Vecchia C, Boccia S, Murisic B, Gallus S. Patterns of smoking prevalence among the elderly in Europe. International journal of environmental research and public health 2013;10(9):4418-31. DOI: https://doi.org/10.3390/ijerph10094418

36. Office for National Statistics. Adult smoking habits in the UK: 2021. [Internet]. London: Office for National Statistics; 2022 Dec 06 [cited: 2023 Feb 01]. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/bulletins/adultsmokinghabitsingreatbritain/2021

37. Australian Institute of Health and Welfare. Alcohol, tobacco & other drugs in Australia. [Internet]. Canberra: Australian Institute of Health and Welfare; 2022 Dec 14 [cited 2023 Feb 01]. Available from: https://www.aihw.gov.au/reports/alcohol/alcohol-tobacco-other-drugs-australia/contents/priority-populations/older-people

38. Najdovska Trajkova N, Mijovic Hristovska B, Mijovic Spasova T, Trenovski B. Tax evasion and avoidance in manufactured cigarettes and hand-rolled tobacco in North Macedonia: Results from a nationwide survey of smokers. Analytica, Skopje, North Macedonia; 2001. Available from: http://tobaccotaxation.org/cms_upload/pages/files/250_mkd_report_tobacco_tax_evasion.pdf

39. Butterworth JE, Campbell JL. Older patients and their GPs: shared decision making in enhancing trust. British Journal of General Practice. 2014 Nov 1;64(628):e709-18. DOI: https://doi.org/10.3399/bjgp14X682297

40. Flocke SA, Miller WL, Crabtree BF. Relationships between physician practice style, patient satisfaction, and attributes of primary care. Journal of Family Practice 2002;51(10):835-41.

41. Frank CC, Feldman S, Wyman R. Caring for older patients in primary care: Wisdom and innovation from Canadian family physicians. Canadian Family Physician 2018;64(6):416-8.

42. Totikj N, Kjosevska E, Stefanovska VV. Organization of health care of elderly people in the city of Skopje-conditions and needs. Arch Pub Health. 2022;14(2):46-57. DOI: https://doi.org/10.3889/aph.2022.6070

43. Lee KH, Xu H, Wu B. Gender differences in quality of life among community-dwelling older adults in low-and middle-income countries: results from the Study on global AGEing and adult health (SAGE). BMC public health. 2020; 20:1-0. DOI: https://doi.org/10.1186/s12889-020-8212-0

44. Borim FS, Neri AL, Francisco PM, Barros MB. Dimensions of self-rated health in older adults. Revista de saude publica. 2014;48:714-22. DOI: https://doi.org/10.1590/S0034-8910.2014048005243

45. Meng Q, Xie Z, Zhang T. A single-item self-rated health measure correlates with objective health status in the elderly: a survey in suburban Beijing. Frontiers in public health. 2014;2:27. DOI: https://doi.org/10.3389/fpubh.2014.00027

46. Kim ES, Park N, Sun JK, Smith J, Peterson C. Life satisfaction and frequency of doctor visits. Psychosomatic medicine 2014;76(1):86. DOI: 10.1097/PSY.0000000000000024

47.Abad-Díez JM, Calderón-Larrañaga A, Poncel-Falcó A, Poblador-Plou B, Calderón-Meza JM, Sicras-Mainar A, Clerencia-Sierra M, Prados-Torres A. Age and gender differences in the prevalence and patterns of multimorbidity in the older population. BMC geriatrics. 2014 Dec;14(1):1-8. DOI: https://doi.org/10.1186/1471-2318-14-75

48. Karadag Arli S, Bakan AB, Varol E, Aslan G. Investigation of pain and life satisfaction in older adults. Geriatrics & gerontology international. 2018 Jan;18(1):5-11. DOI: https://doi.org/10.1111/ggi.13125

49. Buttorff C, Ruder T, Bauman M. Multiple chronic conditions in the United States. Santa Monica, CA: Rand; 2017 Jun 13.

50. Jung MS, Muntaner C, Choi MK. Factors related to perceived life satisfaction among the elderly in South Korea. Journal of Preventive Medicine and Public Health. 2010;43(4):292-300. DOI: 10.3961/jpmph.2010.43.4.292

51. Cinar D, Tas D. Cancer in the elderly. North Clin Istanb. 2015;2(1):73. Available from: DOI: 10.14744/nci.2015.72691

52. Hu SX, Lei WI, Chao KK, Hall BJ, Chung SF. Common chronic health problems and life satisfaction among Macau elderly people. International Journal of Nursing Sciences. 2016 Dec 1;3(4):367-70. DOI: https://doi.org/10.1016/j.ijnss.2016.10.004

53. Meher T, Muhammad T, Gharge S. The association between single and multiple chronic conditions and depression among older population in India: a comparative study between men and women. International Journal of Geriatric Psychiatry. 2022 Jan;37(1).

DOI: https://doi.org/10.1002/gps.5639

54. Ma Y, Xiang Q, Yan C, Liao H, Wang J. Relationship between chronic diseases and depression: the mediating effect of pain. BMC psychiatry. 2021 Dec;21:1-1. DOI: https://doi.org/10.1186/s12888-021-03428-3

55. McKercher CM, Venn AJ, Blizzard L, Nelson MR, Palmer AJ, Ashby MA, Scott JL, Jose MD. Psychosocial factors in adults with chronic kidney disease: characteristics of pilot participants in the Tasmanian Chronic Kidney Disease study. BMC nephrology. 2013 Dec;14(1):1-9. DOI: https://doi.org/10.1186/1471-2369-14-83

56. Dong HJ, Larsson B, Dragioti E, Bernfort L, Levin LÅ, Gerdle B. Factors associated with life satisfaction in older adults with chronic pain (PainS65+). Journal of Pain Research. 2020 Mar 5:475-89. DOI: 10.2147/JPR.S234565

57. Wang S, Liu Y, Lam J, Gao Z. Chronic Illness, Subjective Wellbeing, and Health Services Availability: A Study of Older Adults in Australia. International Journal of Environmental Research and Public Health. 2021 Jul 21;18(15):7718. DOI: https://doi.org/10.3390/ijerph18157718

PUBLIC HEALTH

ANTIMICROBIAL SUSCEPTIBILITY OF SALMONELLA ENTERITIDIS ISOLATED IN THE PERIOD FROM 2020 TO 2022 IN THE SHTIP REGION

Kristina Sudiklieva[1], Golubinka Boshevska[2], Maria Dimitrova[3], Dragan Kochinski[4]

[1] *Faculty of Medical Sciences, Goce Delchev University, Shtip, Republic of North Macedonia*
[2] *Institute of Public Health of the Republic of North Macedonia; Faculty of Medical Sciences, Goce Delchev University, Shtip, Republic of North Macedonia*
[3] *Center of Public Health, Shtip, Republic of North Macedonia*
[4] *Institute of Public Health of the Republic of North Macedonia; Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia*

Citation: Sudiklieva K, Boshevska G, Dimitrova M, Kochinski D. Antimicrobial susceptibility of *Salmonella enteritidis* isolated in the period from 2020 to 2022 in the Shtip region. Arch Pub Health 2024; 16 (1). 38:43.

doi.org/10.3889/aph.2024.6123

Key words: infection, food, antimicrobial susceptibility, *Salmonella enteritidis*

***Correspondence:** Kristina Sudiklieva, Faculty of Medical Sciences, Goce Delchev University, Shtip, Republic of North Macedonia

E-mail: kstojanova25@gmail.com

Received: 6-Mar-2024; **Revised:** 17-Jun-2024; **Accepted:** 20-Jun-2024; **Published:** 01-Jul-2024

Copyright:© 2024. Kristina Sudiklieva, Golubinka Boshevska, Maria Dimitrova, Dragan Kochinski. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

Competing Interests: The author have declared that no competing interests

Abstract

Bacteria of the genus *Salmonella* are widely distributed in nature. They can colonize different hosts and are the most common causes of intestinal infections in humans and animals. The main route of *Salmonella* transmission to humans is by contaminated food, or undercooked eggs and meat. The aim of this study was to analyze the antimicrobial susceptibility of *Salmonella enteritidis*, which was the most frequently isolated Salmonella in the Microbiological Laboratory of the Center of Public Health in Shtip. Materials and methods: A total of 1839 samples (12 rectal swabs and 1827 feces), from persons suspect for salmonellosis in the region of Shtip were investigated for the period 2020 to 2022 year. SS (Salmonella Shigella) agar, Rambach agar, and Selenit F media were used for detection of Salmonella spp., and antimicrobial susceptibility testing of the isolated bacteria is performed with disk diffusion method according EUCAST. Results: *Salmonella enteritidis* is detected in 62 samples (3.37%), isolated strains of *Salmonella enteritidis* demonstrate high resistance to ampicillin 2 μg (37.09%), and multi-resistant strains (6.45%) were also detected. Conclusion: The appearance of ampicillin and multi-resistant strains of *Salmonella enteritidis* in the samples analyzed in our study is a sign of concern and an alarm to initiate a change in the algorithm for the treatment of Salmonella enteritidis infections, especially with the use of fluoroquinolones and cephalosporins (of the third generation). It is recommended to introduce a system for the rational use of antimicrobials in human and veterinary health.

ЈАВНО ЗДРАВЈЕ

АНТИМИКРОБНА ОСЕТЛИВОСТ НА SALMONELLA ENTERITIDIS ИЗОЛИРАНА ВО ПЕРИОДОТ ОД 2020 ДО 2022 ГОДИНА ВО ШТИПСКИОТ РЕГИОН

Кристина Судиклиева[1], Голубинка Бошевска[2], Марија Димитрова[3], Драган Кочински[4]

[1] *Факултет за медицински науки, Универзитет „Гоце Делчев“, Штип, Република Северна Македонија*
[2] *Институт за јавно здравје на Република Северна Македонија; Факултет за медицински науки, Универзитет „Гоце Делчев“, Штип, Република Северна Македонија*
[3] *Центар за јавно здравје, Штип, Република Северна Македонија*
[4] *Институт за јавно здравје на Република Северна Македонија; Медицински факултет, Универзитет “Св. Кирил и Методиј” во Скопје, Република Северна Македонија*

Цитирање: Судиклиева С, Бошевска Г, Димитрова М, Кочински Д. Антимикробна осетливост на *Salmonella enteritidis* изолирана во периодот од 2020 до 2022 година во Штипскиот регион. Арх Ј Здравје 2024; 16(1) 38:43.

doi.org/10.3889/aph.2024.6123

Клучни зборови: инфекција, храна, антимикробна осетливост, *Salmonella enteritidis*

***Кореспонденција:** Кристина Судиклиева, Факултет за медицински науки, Универзитет „Гоце Делчев“, Штип, Република Северна Македонија.

E-mail: kstojanova25@gmail.com

Примено: 6-мар-2024; **Ревидирано:**17-јун-2024; **Прифатено:** 20-јун-2024; **Објавено:** 01-јули-2024

Печатарски права: ©2024. Кристина Судиклиева, Голубинка Бошевска, Марија Димитрова, Драган Кочински. Оваа статија е со отворен пристап дистрибуирана под условите на нелокализирана лиценца, која овозможува неограничена употреба, дистрибуција и репродукција на било кој медиум, доколку се цитираат оригиналниот(ите) автор(и) и изворот.

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Извадок

Бактериите од родот *Salmonella* се широко распространети во природата. Можат да бидат колонизатори на различни домаќини и се најчести предизвикувачи на цревни инфекции кај луѓето и кај животните. Главниот пат на пренесување на бактериите од родот *Salmonella* кај луѓето е преку контаминирана храна или недоволно термички обработени јајца и месо. Цел на трудот беше да се анализира антимикробната осетливост на детектираните соеви на *Salmonella enteritidis*, која беше најчест детектиран вид во микробиолошката лабораторија на Центарот за јавно здравје во Штип. Материјал и методи: Вкупниот број на испитани примероци во микробиолошката лабораторија на Центарот за јавно здравје во Штип во периодот од 2020 до 2022 година е 1839, од кои 12 ректални брисеви и 1827 копрокултури од лица за кои постои сомневање дека имаат салмонелоза во Штипскиот регион. За детекција на Salmonella spp. се користени: SS (Salmonella Shigella) агар, Rambach агар, Selenit F бујон, а детекцијата на антимикробната осетливост на изолираната бактерија се врши со диск дифузиона метода согласно ЕУКАСТ методологијата. Резултати: *Salmonella enteritidis* е детектирана кај 62 примероци (3.37%) во регионот на Штип. Изолираните соеви *Salmonella enteritidis* покажуваат висока резистенција кон ампицилин 2 μg (37.09%), а детектирани се и мултирезистентни соеви (6.45%). Заклучок: Појавата на висока резистенција кон ампицилин и мултирезистентни соеви на Salmonella enteritidis во анализираните примероци претставува знак за загриженост и аларм за иницирање на промена на алгоритамот за лекување на инфекциите со *Salmonella enteritidis*, особено со примената на флуорокинолоните и цефалоспорините (од трета генерација). Се препорачува воведување на систем за рационална употреба на антимикробните средства во хуманото и ветеринарно здравје

Introduction

Bacteria of the genus *Salmonella* are widely distributed in nature. They can colonize different hosts and are the most common causes of intestinal infections in humans and animals. The main route of Salmonella transmission to humans is by contaminated food, or undercooked eggs and meat.[1,2] Salmonellosis caused by non-typhoidal serotypes of *Salmonella* usually presents as self-limiting mild diarrhea, with cramps and fever, however it can cause severe invasive infections. *Salmonella* infection is the second most reported zoonotic disease in humans, with 60,050 reported cases in the EU in 2021, and it is a bacterium which is the cause of the largest number of food-borne outbreaks.[3] According to the report by the Institute of Public Health of North Macedonia, in the group of intestinal acute infectious diseases, salmonellosis is the third most common infectious disease with incidence of 9.1.[4]

Samples from people suspected of having salmonellosis from the Shtip region, which includes the settlements around the towns of Shtip, Probishtip and Radovish, are sent to the Microbiological Laboratory of the Center of Public Health in Shtip for detection of the bacteria and their serotype and for determination of the antimicrobial sensitivity which is relevant for appropriate patients' therapy.

The aim of this paper was to show the antimicrobial susceptibility of *Salmonella enteritidis* isolated from people with symptoms suspicious of having salmonellosis in the Shtip region.

Materials and methods

The study was carried out in the Microbiological Laboratory of the Center of Public Health in Shtip in the period from 2020 to 2022. Data from the laboratory examination of human samples (coproculture and rectal smear) from persons with salmonellosis symptoms were analyzed. During the period of examination, the total number of examined samples was 1839, of which 12 were rectal swabs and 1827 coprocultures. *Salmonella spp*. were detected by using nutrient media: SS (Salmonella Shigella) agar, Rambach agar, Selenite F broth. After incubation at 37°C for 18 to 24 hours in aerobic conditions, a plate latex agglutination was performed to identify bacterial growth. Antimicrobial susceptibility of the isolated bacteria was detected by disk diffusion method using Mueller Hinton agar by EUCAST methodology[5].

The following antibiotics were used: Ceftriaxone (30), Cefixime (5), Cefalexin (30), Cefuroxime (30), Ampicillin (2), Ampicillin (10), Amoxicillin / Clavulanic Acid (20-10), Piperacillin/Tazobactam (30-6), Gentamycin (10), Amikacin (30), Ciprofloxacin (5), Levofloxacin (5), Moxifloxacin (5), Norfloxacin (10), Trimethoprim/Sulfamethoxazole (1.25-23.75), Imipenem (10), Ertapenem (10), Meropenem (10). After incubation for 18-24 hours at 37°C, the zones of inhibition/diameter were measured with a ruler which interpreted *Salmonella enteritidis* susceptibility to the antibiotic.

Results

In the analyzed period, there were 1839 examined samples suspected of salmonellosis. *Salmonella enteritidis* was isolated in 62 samples (3.37%) or in 3 rectal swabs and 59 coprocultures.

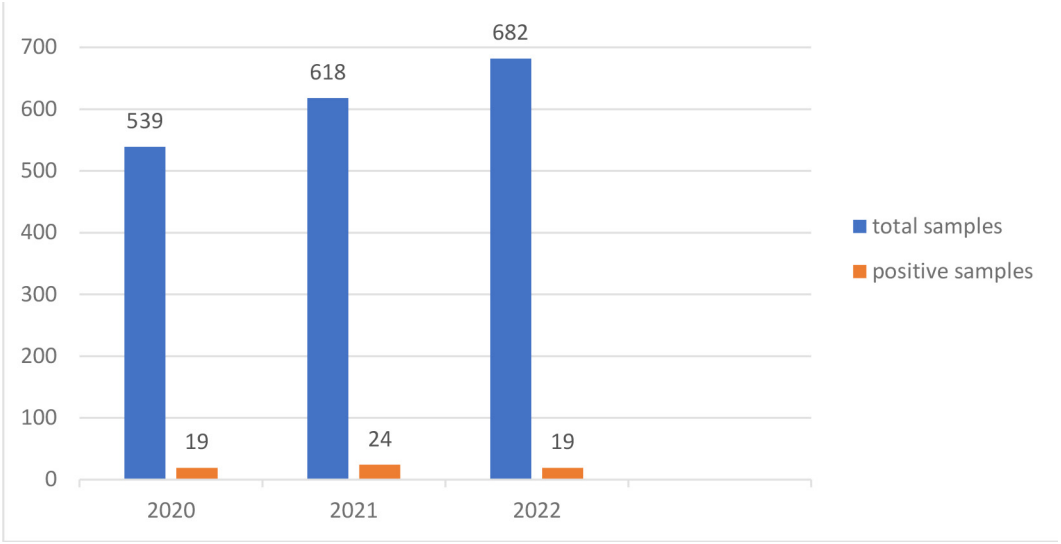


Figure 1. Total number of examined and positive samples of *Salmonella enteritidis*

As shown in Figure 1, in 2020, *Salmonella enteritidis* was isolated in 19 (3.53%) samples of a total of 539 samples received. In 2021, 24 (3.88%) samples of 618 tested samples were positive. In 2022, there were 19 (2.79%) positive samples of 682 tested samples.

Table 1 Antimicrobial susceptibility of isolated cases of *Salmonella enteritidis*

Antibiotic (µg)	Number of samples with isolated *Salmonella enteritidis*	Number of bacteria sensitive to the antibiotic	Number of bacteria resistant to the antibiotic
Ceftriaxone (30)	62	62	/
Cefixime (5)	62	62	/
Cefalexin (30)	62	62	/
Cefuroxime (30)	62	62	/
Ampicillin (2)	62	39	23
Ampicillin (10)	62	57	5
Amoxicillin/Clavulanic Acid (20-10)	62	62	/
Piperacillin/Tazobactam (30-6)	62	62	/
Gentamycin (10)	62	62	/
Amikacin (30)	62	62	/
Ciprofloxacin (5)	62	58	4
Levofloxacin (5)	62	58	4
Moxifloxacin (5)	62	58	4

Norfloxacin (10)	62	58	4
Nalidixic Acid	/	/	/
Trimethoprim/	62	62	/
Sulfamethoxazole (1.25-23.75)	62	62	/
Imipenem (10)	62	62	/
Ertapenem (10)	62	62	/
Meropenem (10)	62	62	/

According to the results shown in Table 1, it can be seen that:

- 23 (37.09%) *Salmonella* isolates were resistant to Ampicillin 2.
- 5 (8.06%) *Salmonella* isolates were resistant to Ampicillin 10 μg.
- 4 (6.45%) *Salmonella* isolates were resistant to fluroquinolones (Ciprofloxacin, Levofloxacin, Moxifloxacin, Norfloxacin).

The Laboratory in the Center of Public Health in Shtip detected *Salmonella enteritidis* in 36 men (58.06%) and 26 women (41.94%). The largest number of positive results were found among patients in the age group of 0-9 years, a total of 18 people (29.03%). In terms of residence area, a larger number of patients were urban residents compared to rural residents, or 48 (77.42%) versus 11 persons (17.74%). Regarding hospitalization, 17 persons (27.42%) were treated in hospital and 45 persons (72.58%) on an outpatient basis. Although the bacteria was detected throughout the year, most of the positive isolates were found during summer, i.e. in July and August (Table 2).

Table 2 Number of patients with isolated *Salmonella enteritidis* according to months in the year

Year/ month	2020	2021	2022	Total
January	3	/	1	4
February	/	/	1	1
March	/	/	3	3
April	/	/	4	4
May	/	1	3	5
June	/	4	3	7
July	/	10	/	10
August	4	4	2	10
September	1	/	/	1
October	7	/	1	8
November	3	3	/	6
December	1	2	1	4

Discussion

Salmonella infections are challenge and public health problem for each country regardless of its development and availability of health care services. Sometimes, several countries are affected at the same time, as confirmed by the latest European Center for Disease Control report, from October 2023.[6,7] Well-developed microbiological capacities for rapid and early detection of *Salmonella spp.*, as well as determination of their antimicrobial sensitivity are of significant importance for prevention of disease spread and for patients treatment in a timely manner. *Salmonella enteritidis* was detected in the Shtip region in each of the analyzed years found in examined samples. The examination of the local susceptibility/resistance of *Salmonella enteritidis* by the Center of Public Health in the Shtip region (the towns of Shtip, Probishtip and Radovish) is important for patients' adequate empiric therapy and for development of local guidelines for therapy. Forty-five percents of the isolated strains in Shtip showed resistance to Ampicillin, which is in agreement with the equally high resistance (from 20 – 50%) in a number of European countries.[8,9] The high resistance (from 20 – 50%) to Ciprofloxacin[8,10] and Erythromycin[8,11] was reported by 5 countries in Europe, and only one country (Poland) reported an extremely high resistance (more than 70%)[8.] The appearance of multiresistant strains of *Salmonella enteritidis* (6.45%) in the analyzed samples in our study raises concern and an alarm to initiate modifications in the treatment algorithm for *Salmonella enteritidis* infections, especially in the usage of fluoroquinolones and cephalosporins (of third generation)8,10. According to the European Center for Disease Prevention and Control (ECDC), the resistance to these groups of drugs is hazardous to public health. Resistance to these Salmonella enteritidis types is related to the increased antibiotics usage in both animal and human populations[6,8,13]. Therefore, a better system for rational use of antimicrobial agents is recommended to be introduced in human and veterinary medicine[12,13].

Conclusion

The most frequently isolated bacteria from the genus *Salmonella* in the Shtip region is *Salmonella enteritidis*. The strains isolated in the region by the Center of Public Health in Shtip showed a high resistance to Ampicillin. Multiresistant strains of *Salmonella enteritidis* were detected. This should be the reason for strengthened and organized public health response and taking measures for prudent use of antibiotics in veterinary and human medicine.

References

1. Sanchez S, Hofacre CL, Lee MD, Maurer JJ, Doyle M. Animal sources of salmonellosis in humans. J Am Vet Med Assoc. 2002;221(4):492-497 DOI: 10.2460/javma.2002.221.492
2. Shinohara NKS, Bezerra de Barros V, Jimenez SMC, Machado ECL, Fireman Dutra RA, Filho JL. Salmonella spp important pathogenic agent transmitted through foodstuffs. Cien Saude Colet. 2008; 13(5):1675-

1683 DOI: 10.1590/s1413-81232008000500031

3. Anderson D.Hohmann EL. Nontypoidal Salmonellosis. Clinical infection disease 2001;32(2):263-269 DOI: 10.1086/318457
4. Извештај за здравјето и здравствената заштита на населението во Република Северна Македонија во 2022, Институт за јавно здравје на Република Северна Македонија https://www.iph.mk/Upload/Documents/Izvestaj%20za%20zdravje%202022.pdf. 2022.
5. EUCAST, European Committee on Antimicrobial Susceptibility Testing, Clinical breakpoints - breakpoints and guidance 2023. https://www.eucast.org/clinical_breakpoints
6. European Centre for Disease Prevention and Control. Ongoing clusters of Salmonella Enteritidis ST11 linked to consumption of chicken meat, Threats and outbreaks of salmonellosis, November 2022
7. European Food Safety Authority (EFSA), European Centre for Disease Prevention and Control (ECDC). The European Union One Health 2021. Zoonoses Report: EFSA,ECDC, 2021,2022. https://www.ecdc.europa.eu/en/infectious-diseases-and-public-health/salmonellosis/threats-and-outbreaks
8. European Food Safety Authority (EFSA); Antimicrobial resistance - Data visualisation tool, 2021 https://multimedia.efsa.europa.eu/dataviz-2021/index.htm
9. Alcaine SD, Warnick LD, Wiedmann M. Antimicrobial resistance in nontyphoidal Salmonella. J Food Prot 2007; 70 (3): 780–790 DOI: 10.4315/0362-028x-70.3.780
10. Kaichao C, Donga N, Edward WCh, Chena S. Transmission of ciprofloxacin resistance in Salmonella mediated by a novel type of conjugative helper plasmids. Emerg Microbes Infect. 2019; 8 (1): 857-865 DOI: 10.1080/22221751.2019.1626197
11. Adzitey F. Antibiotic resistance of Escherichia coli and Salmonella enterica isolated from cabbage and lettuce samples in Tamale metropolis of Ghana. International Journal of Food Contamination. 2018; 5,7.DOI: https://doi.org/10.1186/s40550-018-0068-z
12. Carattoli A. Plasmid-mediated antimicrobial resistance in Salmonella enterica. Curr Issues Mol Biol. 2003;5(4):113-122 PMID:12921226
13. Commission notice, Guidelines for the prudent use of antimicrobials in veterinary medicine, (2015/C 299/04). Official Journal of the European Union. 2015; C 299/7 - C 299/26 DOI: https://doi.org/10.1016/j.ejps.2023.106473

PUBLIC HEALTH

ASSESSMENT OF THE BURDEN OF SALMONELLOSIS IN THE REPUBLIC OF NORTH MACEDONIA

Aneta Kostova[1], Gordana Ristovska[1], Darko Kotev[2]

[1] *Institute of the Public Health of the Republic of North Macedonia; Ss. Cyril and Methodius University in Skopje, Faculty of Medicine, Republic of North Macedonia*

[2] *Center for Public Health, Veles, Republic of North Macedonia*

Citation: Kostova A, Ristovska G, Kotev D. Assessment of the burden of salmonellosis in the Republic of North Macedonia.Arch Pub Health 2024; 16 (1). 44:55.

doi.org/10.3889/aph.2024.6113

Online First

Key words: burden, salmonellosis, unsafe food, YLD, DALY

***Correspondence:** Aneta Kostova, Institute of the Public Health of the Republic of North Macedonia, Скопје, Republic of North Macedonia. E-mail: kostovaaneta@ymail.com

Received: 29-Dec-2023; **Revised:** 25-Mar-2024; **Accepted:** 3-Apr-2024; **Published:** 01-Jul-2024

Copyright:© 2024. Aneta Kostova, Gordana Ristovska, Darko Kotev. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

Competing Interests: The author have declared that no competing interests

Abstract

Food-related diseases still cause a significant public health, economic and social burden worldwide. Each year, 1 in 10 people become ill from food contaminated with microbes or chemical agents, resulting in 600 million illnesses, 420,000 deaths and loss of 33 million healthy life years globally. The aim of this study was to determine the burden of infections caused by Salmonella spp. at national level, and to determine the public health and economic impact. Material and methods: Data from the National database of infectious diseases for 2019 were used; incidence, years of life lost (YLL), years lost due to disability (YLD), disability-adjusted life years (DALY) and economic losses were determined. Results: The analysis included 197 salmonellosis patients, of which 101 or 51.3% were male patients and 96 or 48.7% were female patients. The largest number of cases occurred in month XI (November) with 46 cases. The most represented age group were children aged 0-5 years (79 patients). The largest number of cases were registered in Skopje - 80 cases (40.6%). Data analysis showed a significant association between clinically established diagnosis and hospitalization in patients with salmonellosis. DALY was 19.9 or 0.96 DALY per 100,000 population. The value of productivity losses was 6,637,665 denars or €107,930. Conclusion: This is the first national study of salmonellosis burden and should serve as an important resource for focusing activities that will reduce this burden. The findings of the study could be the basis for the development of strategies at the regional and national level.

ЈАВНО ЗДРАВЈЕ

ПРОЦЕНКА НА ОПТОВАРУВАЊЕТО СО САЛМОНЕЛОЗА ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА

Анета Костова[1], Гордана Ристовска[1], Дарко Котев[2]

[1] *Институт за јавно здравје на Република Северна Македонија; Универзитет Св. Кирил и Методиј во Скопје, Медицински факултет, Република Северна Македонија*

[2] *Центар за јавно здравје, Велес, Република Северна Македонија*

Цитирање: Костова А, Ристовска Г, Котев Д. Проценка на оптоварувањето со салмонелоза во Република Северна Македонија. Арх Ј Здравје 2024;16 (1) 44:55.

doi.org/10.3889/aph.2022.6113

Клучни зборови: оптоварување, салмонелоза, небезбедна храна, YLD, DALY

***Кореспонденција:** Анета Костова, Институт за јавно здравје на Република Северна Македонија, Северна Македонија.

E-mail: kostovaaneta@ymail.com

Примено:29-дек-2023;**Ревидирано:**28-мар-2024; **Прифатено:** 3-апр-2024; **Објавено:** 01-јули-2024

Печатарски права: ©2024. Анета Костова, Гордана Ристовска, Дарко Котев. Оваа статија е со отворен пристап дистрибуирана под условите на нелокализирана лиценца, која овозможува неограничена употреба, дистрибуција и репродукција на било кој медиум, доколку се цитираат оригиналниот(ите) автор(и) и изворот.

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Извадок

Болестите поврзани со храната сè уште предизвикуваат значаен јавноздравствен, економски и социјален товар ширум светот. Секоја година, 1 од 10 луѓе се разболуваат од храна контаминирана со микроби или хемиски агенси, што резултира со 600 милиони болести, 420 000 смртни случаи и губење на 33 милиони години здрав живот на глобално ниво. Целта на оваа студија беше да се утврди оптовареноста на инфекции предизвикани од на национално ниво и да се утврди јавноздравственото и економско влијание. Материјал и методи: Користени се податоци од националната база на податоци за заразни болести за 2019 година; утврдена е инциденцијата, изгубени години на живот (YLL), години изгубени поради инвалидитет (YLD), години на живот приспособени според инвалидитет (DALY) и економски загуби. Резултати: Анализата опфати 197 пациенти со салмонелоза, од кои 101 или 51,3% беа пациенти од машки пол и 96 или 48,7% пациенти од женски пол. Најголем број случаи имаше во XI месец (ноември) - 46 случаи. Најзастапена возрасна група беа децата на возраст од 0-5 години (79 пациенти). Најголем број случаи беа регистрирани во Скопје - 80 случаи (40,6%). Анализата на податоците покажа значајна поврзаност помеѓу клинички утврдената дијагноза и хоспитализацијата кај пациенти со салмонелоза. DALY изнесува 19,9 или 0,96 DALY на 100 000 жители. Вредноста на загубите во продуктивноста е 6.637.665 денари или 107.930 €. Заклучок: Ова е прва национална студија за оптоварувањето со салмонелоза и треба да послужи како важен ресурс за фокусирање на активностите што ќе го намалат овој товар. Наодите од студијата би можеле да бидат основа за развој на стратегии на регионално и национално ниво.

Introduction

"Disease burden" is defined as the incidence and/or prevalence of morbidity, disability, and mortality associated with acute and chronic disease manifestations.[1] The overall burden of disease is estimated using various composite measures of population health status such as DALY, which is a time-based measure that combines years of life lost due to premature mortality and years lost from life due to the time of living in disability or conditions with impaired health.[2]

Food-borne diseases (FBD) still cause a significant public health, economic and social burden worldwide. Recognizing the need to measure the burden and distribution of FBD and encourage evidence-informed policies, in 2015 the World Health Organization (WHO) published the first estimates of global and regional disease burden for 31 foodborne hazards.[3] The results showed that, each year, 1 in 10 people become ill from food contaminated with microbes or chemical agents, resulting in 600 million illnesses, 420,000 deaths and loss of 33 million healthy life years globally.4 While these estimates were critical to raising awareness, they were the product of a massive research initiative that faced significant data gaps. They significantly did not offer the precision needed to identify priorities at the national level, and were not always able to use all data from available resources. Accurate national estimates of the burden of disease are essential to identify the most important diseases and hazards in a country, as well as the foods that contribute most to these diseases and the interventions needed to effectively prevent them.[5]

The Foodborne Burden of Disease Epidemiology Reference Group (FERG) was established by WHO in 2007 to estimate the global and regional burden of FBD (across the six WHO regions). Other FERG goals were to strengthen the capacity of countries to assess their FBD burden, and to increase the number of countries that have undertaken such a study. FERG activities to promote national studies have included building capacity and promoting the use of disease burden information in evidence-informed policy making. The FERG Study Task Force (CSTF) has developed a suite of tools and resources to support national studies. Pilot studies were conducted in Albania, Japan, Thailand and Uganda and provided important practical lessons. In particular, data gaps hampered DALY calculations on several occasions. These gaps included information needed to assign etiology for syndromes, such as acute gastrointestinal disease, and data on the incidence of diseases caused by some hazards.[6]

It is useful to prioritize FBD burden estimates in food security policies and allocate resources where food security risks are highest. The experiences of established studies and their mechanisms of translating evidence into policy can provide guidance and suggest processes for cooperative national studies.[7]

WHO is supporting countries to estimate the national burden of FBD through technical assistance and the development of guidance for estimating the burden of FBD caused by microbial agents. The guidance includes a complete picture of the requirements, enabling factors, challenges and opportunities for assessing the

burden of FBD and the steps for performing the assessments.[5,8]

The aim of this study was to determine the burden of infections caused by *Salmonella spp*. related to unsafe food at national level, and to determine the public health impact and the economic impact.

Sub-objectives of the paper were:

- To determine the incidence and morbidity of *Salmonella spp*. related to unsafe food during 2019;
- To determine the burden of *Salmonella spp*. through DALY indicator;
- To determine the economic impact of *Salmonella spp*. related to unsafe food.

Material and methods

Data from the National database for infectious diseases from the Institute of Public Health of the Republic of North Macedonia for 2019 was used. Family physicians are obliged to fill out a mandatory notification for infectious diseases at each occurrence of an infectious disease among patients. These records are delivered to the Centers for Public Health and further the information is forwarded to the Institute of Public Health of RNM.

This study includes a DALY measure, which combines information on morbidity, mortality and disability caused by diseases. DALY is a more comprehensive metric than incidence or prevalence rate; it is now the most widely used public health metric for disease burden studies and the key measure in the Global Burden of Disease (GBD) Study.

DALY is a metric of the health gap, a measurement of years of healthy life lost due to a disease or risk factors. DALYs are calculated by adding the number of years of life lost due to premature mortality (YLL) and the number of years lived with disability (YLD), adjusted for severity:

DALY=YLL+YLD

YLL is the product of the number of deaths (M) and the average remaining life expectancy (RLE) at the time of death:

YLL=M x RLE

The 2010 GBD study introduced an approach to calculating burden of disease – a prevalence-based approach. This approach reflects the current burden of disease as a result of past events. In other words, the health status of a population is assessed at a point in time, and prevalent diseases are attributed to initial events that occurred in the past. The definition of YLL is the same as in the incidence-based approach, but YLD is defined as the product of the number of prevalent cases (P) and the disability weight (DW), which reflects the reduction in health-related quality of life on a scale of 0 (no effect on full health) to 1 (death).

YLDprev=P x DW

To estimate YLL, the use of a standard life table is recommended. YLLs reflect the ideal life expectancy, based on the lowest possible mortality given the currently available data. There are different standard life tables developed for the WHO Global Health Assessment (GHA) and GBD studies by the Institute for Health Metrics and Evaluation (IHME), but in this study we used the life table for the Republic of North Macedonia.

The weight of each health outcome is represented by disability weights

(DW). The DW value is between 0 and 1, where 0 represents full health and 1 represents death. DW can be interpreted as a proportional decrease in good health due to an unfavorable health condition. DW for *Salmonella spp*. is 0.101.

Given the difficulty of making detailed estimates of the value of YLL or YLD, a frequently used shortcut is to use a country's per capita gross domestic product (GDP) as a measure of lost productivity. For every year lost to illness, disability or premature death, the country loses the economic output associated with that year. Foodborne disease is therefore represented as a drain on the country's productivity. The calculation is represented by the following formula:

$$VPi = Bi \times Yi$$

where VPi is the value of productivity losses associated with foodborne diseases in country i; Bi is the total DALY burden of foodborne diseases in country i; and Yi is GDP per capita for country i. We expressed this value in local currency (denars) or in euros to make comparison between countries.

Chi-square, Kolmogorov-Smirnov one- or two-sample test, and Fisher exact test were used to compare specific features between two groups. Cramer'V was used to determine the association between two nominal variables.

Results

During 2019, 197 patients with salmonellosis were registered, of which 101 or 51.3% were male patients and 96 or 48.7% were female patients.

The analysis found a non-significant difference between male and female patients (Chi-square:0.127; df=1; p=0.722).

Regarding the month of disease occurrence, the largest number of salmonellosis cases occurred in month XI (November) - 46 cases, followed by month X (October) - 37 cases. The lowest number of cases occurred in month II (February) - 4 cases, and then in month IV (April) - 5 cases. The structure of salmonellosis cases by month is shown in Figure 1, which shows the trend of the increase of the disease during the year.

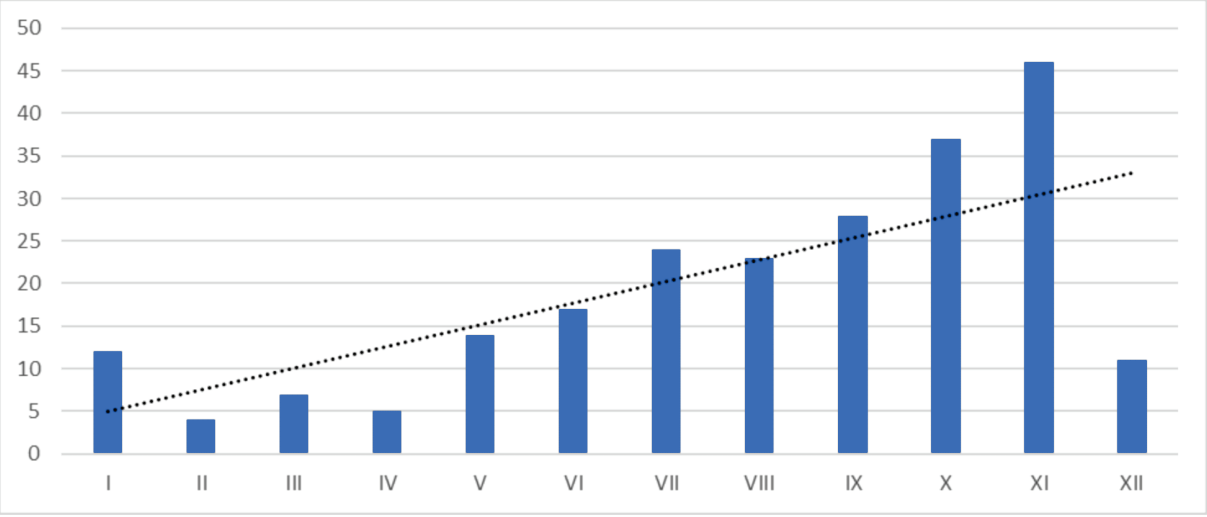


Figure 1. Number of salmonellosis cases by month

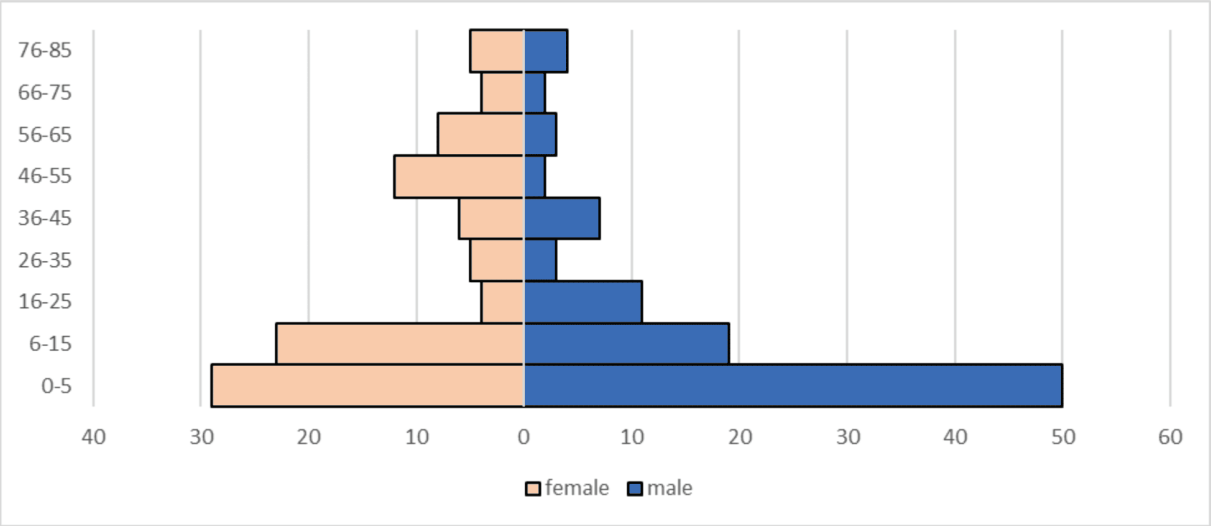


Figure 2. Presentation of the age pyramid for salmonellosis in 2019

Regarding the age of patients, the most represented age group among female patients was 0-5 years (29 patients), followed by the age group 6-15 years (29 patients). The least represented female age group was 16-25 years and 66-75 years with 4 patients. Regarding male patients, the most represented age group was 0-5 years (50 patients), followed by the age group 6-15 years (19 patients). The structure by age groups of patients is shown in Figure 2.

In 2019, the highest number of cases of salmonellosis were registered in Skopje - 80 cases (40.6%), followed by Kumanovo - 22 cases (11.2%). In the same period, the lowest number of cases were registered in Debar, Kavadarci, Negotino and Pehchevo with only one case each (0.5%). The presentation of salmonellosis cases by municipalities is illustrated in Figure 3.

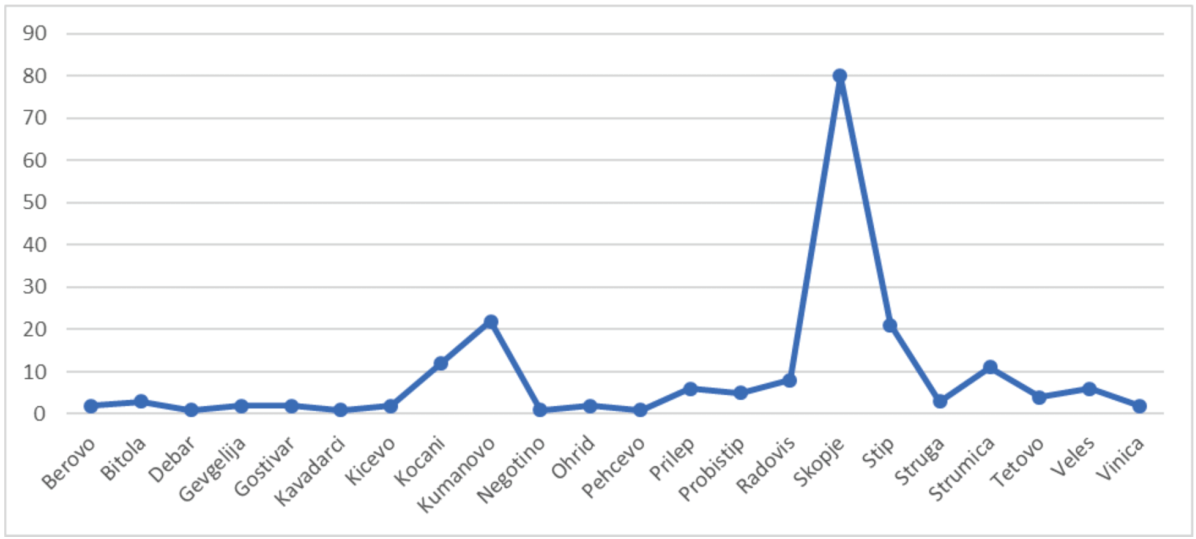


Figure 3. Presentation of Salmonellosis cases by municipalities in 2019

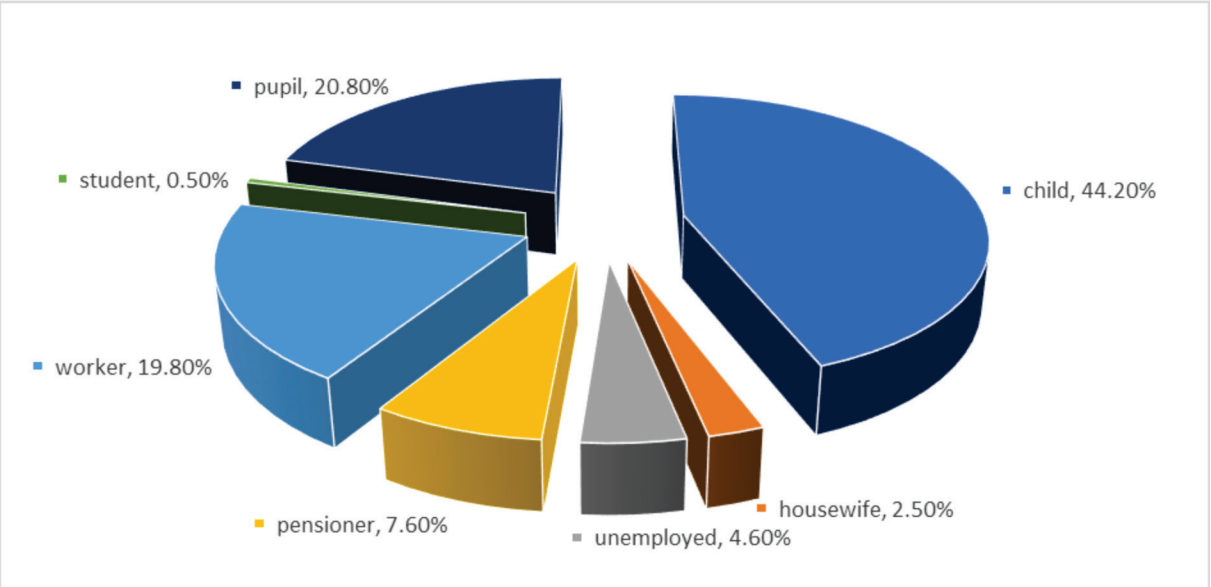


Figure 4. Structure of persons infected with salmonellosis

The analysis of the structure of individuals infected with salmonellosis, in terms of work status, showed that 87 (44.2%) were children, 41 (20.8%) were pupils, one patient was a student (0.5%), 39 (19.8%) were workers, 9 (4.6%) unemployed, 5 (2.5%) housewives and 15 (7.6%) were retired persons. (Figure 4).

The difference between persons with salmonellosis in terms of work status was significant (Kolmogorov-Smirnov Z:3.774; p<0.001)

Table 1. Hospitalization for salmonellosis according to gender

		Hospitalization		Total
		yes	no	
Gender	male	31 (15.7%)	70 (35.5%)	101 (51.3%)
	female	37 (18.8%)	59 (29.9%)	96 (48.7%)
Total		68 (34.5%)	129 (65.5%)	197 (100%)

Regarding hospitalization, the analysis showed that male patients were hospitalized in 31 cases (15.7%), while female patients were hospitalized in 37 cases (18.8%) (Table 1).

The analysis showed a non-significant difference between male and female patients in terms of hospitalization (Chi-square: 1.341; df=1; p=0.247).

Table 2. Hospitalizations for salmonellosis by work status in 2019

		Hospitalization		Total
		yes	no	
Gender	children	33 (16.8%)	54 (27.4%)	87 (44.2%)
	pupils	15 (7.6%)	26 (13.2%)	41 (20.8%)
	students	0	1 (0.5%)	1 (0.5%)
	workers	12 (6.1%)	27 (13.7%)	39 (19.8%)

	unemployed	3 (1.5%)	6 (3.0%)	9 (4.6%)
	housewives	0	5 (2.5%)	5 (2.5%)
	pensioners	5 (2.5%)	10 (5.1%)	15 (17.6%)
Total		68 (34.5%)	129 (65.5%)	197 (100%)

Regarding hospitalization for salmonellosis by work status, the analysis showed that the largest number of hospitalized patients were children - 33 (16.8%), followed by pupils - 15 (7.6%). There were no hospitalized patients with working status, students and housewives (Table 2).

The analysis showed a non-significant difference between patients by work status in terms of hospitalization (Fisher's Exact Test: 3.660; p=0.758).

Data analysis determined a non-significant association between laboratory-confirmed diagnosis and hospitalization among patients with salmonellosis (Cramer's V:0.117; p=0.099).

Data analysis showed a significant association between clinically confirmed diagnosis and hospitalization in patients with salmonellosis. Most patients who were hospitalized had a clinically confirmed diagnosis (Cramer's V:0.223; p=0.002).

DALYs and economic burden of *Salmonella spp.*

The morbidity rate was 9.49 per 100,000 inhabitants.

Mb = (197/2076255) x 100,000 = 9.49 (5).

The sex-specific morbidity rate was 9.26 per 100,000 people for women and 9.71 per 100,000 people for men.

$Mb_{Females}$ = (96 / 1036736) x 100,000 = 9.26

Mb_{Males} = (101 / 1039958) x 100,000 = 9.71

The rate of specific morbidity by work status was 5.08 per 100,000 population for workers and 8.42 per 100,000 population for unemployed (unemployed + housewives).

$Mb_{workers}$ = 39 / 797651 x 100 000 = 5.08

$Mb_{unemployed}$ = 14 / 166363 x 100 000 = 8.42

The incidence rate was 0.095 per 1,000 population.

Incidence rate = (197/2076255) x 1000 = 0.095

DALY = YLL + YLD (1)

YLL = 0

YLD = 197 x dw = 197 x 0.101 = 19.9

dw for Salmonellosis dw = 0.101

DALY = 0 + 19.9 = 19.9

DALY was 19.9 or 0.96 DALY per 100,000 population

DALYfemales = 0 + (96 x 0.101) = 0 + 9.7 = 9.7 (11)

DALYmales = 0 + (101 x 0.101) = 0 + 10.2 = 10.2 (12)

The value of productivity losses was 6,637,665 MKD or 107,930 €

DALY x GDP = 19.9 x 333 551 MKD = 6 637 665 MKD

Discussion

A study on the global burden of disease associated with unsafe food found that *Salmonella spp*. caused 78,707,590 cases of disease worldwide in 2010. Salmonella was responsible for 59,153 deaths in the same year. It caused 4,067,920 DALYs and 78,306 YLDs and 3,976,380 YLLs.[9]

In SEAR B and SEAR C (South East Asian subregion) the burden was 59 DALYs and 58 DALYs per 100,000 population, respectively. In the Eastern Mediterranean region, a burden was found in EMR B with 50 DALYs and in EMR D with 67 DALYs per 100,000 population. In the North American region, the lowest prevalence of diseases related to unsafe food was observed in AMR A with 9 DALYs, AMR B with 11 DALYs and AMR D with 14 DALYs per 100,000 population. In the European region, in EUR A with 12 DALYs, in EUR B (where the Republic of North Macedonia belongs) with 12 DALYs I EUR C with 11 DALYs per 100,000 population. In the Western Pacific region, a burden was found in WPR A and WPR B with 9 DALYs per 100,000 population.[9]

According to the results obtained in our study, *Salmonella spp*. caused a burden of 19.9 DALYs or 0.96 DALYs per 100,000 population which was lower than in the European Region

Numbers were also high in the WHO European Region, where non-typhoidal *Salmonella spp*. took the first place in the ranking of DALYs and deaths due to food hazards, causing 107,000 DALYs and 1854 deaths per year. The median DALY rate was 8 (95% UI 5–14) DALYs per 100,000 population per year. In addition, non-typhoidal Salmonella spp. was estimated to cause 1.7 million cases of illness annually, making it the third most common cause of foodborne illness in the region[10].

In 2014, in the European Union alone, there were over 85,000 reported cases of human salmonellosis, with 65 deaths. The two most commonly reported *Salmonella* serovars in the European Union were *S. Enteritidis* and *S. Typhi*. The European Food Safety Authority (EFSA) estimated that the overall economic burden of human salmonellosis may be as high as 3 billion per year. A significant downward trend in human salmonellosis in the European Union was observed, which was attributed to the joint actions of many actors, including enhanced control programs of *Salmonella spp*. for poultry[11].

In total, 90,105 cases of salmonellosis in humans were reported from 28 EU Member States in 2019. Of these, 87,923 were confirmed cases resulting in an EU reporting rate of 20.0 cases per 100,000 population. This was at the same level as in 2018 (20.1 cases per 100,000 inhabitants). As in the previous year, the highest rates in 2019 were reported by the Czech Republic (122.2 cases per 100,000 population), Slovakia (91.6 cases per 100,000 population), Hungary (45.6), Croatia (32.1), France (27.8), Malta (26.5), Lithuania (26.3), Latvia (2.8) and Belgium (22.1 per 100,000 population), while the lowest rates were reported by Cyprus, Greece, Ireland, Italy, Portugal and Romania (≤ 7.1 cases per 100,000 population).[12]

According to the results of our study, salmonellosis was registered in 197 cases or a rate of 9.49 per 100,000 population, which was lower than the rate in the European Union, but some European countries, such as Bulgaria (8.5 per 100,000 population) and the Netherlands presented similar results (10.8 per 100,000 population).

In total, 15 EU member states provided information on hospitalization. The proportion of confirmed

cases with known hospitalization information was 44.5% at EU level. Among them, the percentage of hospitalized cases was 42.5%, which was approximately at the same level as in 2018. The highest proportions of hospitalized cases were reported, as in previous years, in Cyprus, Greece, Lithuania, Poland and the United Kingdom, where majority of patients were hospitalized. The high percentage of hospitalized cases was probably due to the surveillance focus on severe diseases requiring hospital care. Two of these countries also reported the lowest reporting rates for salmonellosis, indicating that the surveillance systems in these countries primarily recorded the more severe cases.[13]

According to the results of our research, 34.5% of those infected with Salmonellosis were hospitalized.

In total, 17 EU member states provided salmonellosis outcome data and, among them, 11 member states reported 140 fatal cases resulting in an EU fatality rate of 0.22%. Here 46 deaths (32.9%) were reported by the United Kingdom.[12]

In a study conducted in Japan in 2011, it was determined that non-typhoid *Salmonella spp*. 3145 DALYs.[13]

A 2009 study from Thailand found that the incidence of *Salmonella spp*. infections was 1.74.[14]

Salmonella spp. ranks third as a cause of foodborne illness (12%), second as a cause of hospitalization (24%), and first as a cause of death (27%) in France[15]. In the EU, there are more than 91,000 reported Salmonella infections each year[16]. In 2016, 94,530 human salmonellosis cases were reported in the EU, of which *S. enteritidis* accounted for 59% of all cases.

There was also an 11.5% increase in the trend of reported foodborne outbreaks compared to 2015 and *S. enteriditis* was responsible for one in six outbreaks in 2016. Salmonella was responsible for the greatest health burden with 1766 hospitalizations (45,6%) and 50% of all deaths in epidemic cases[17]. In Australia, gastroenteritis was responsible for an estimated $811 million annually in costs associated with treatments, deaths, lost productive hours, and government oversight[18].

From 2009 to 2015 there was a dramatic increase in hospitalizations due to salmonellosis among EU/EEA member states. The joint efforts of the European Commission and stakeholders tried to match the number of cases to 12,510 hospitalizations in 2015. However, recent data shows that the trend is rising again with 16,816 registered hospitalizations in 2018. The USDA ERS[19] estimated the economic cost of Salmonella (non-typhoidal) as $3.66 billion for 2014 considering lost wages, medical costs, premature deaths, caseloads, and lost productivity. In the EU, these costs are estimated to exceed €3 billion per year[20].

In terms of annual costs for Salmonella in Sweden, they amounted to 25.3 million euros, ranking second, just behind Campylobacter[21].

Conclusion

This is the first national study of salmonellosis burden and should serve as an important resource for focusing activities that will reduce this burden. This requires a sustained,

multi-sectoral response from the competent authorities and sectors in the country, including the implementation of food safety standards and effective surveillance networks at national, regional and global level. This will require concerted efforts by all stakeholders in the food chain, from primary production to consumers. The diversity of food hazards indicates the need for a multifaceted strategy, with priorities tailored to each region. While national studies may further refine priorities and are highly recommended, the current findings could already be the basis for developing strategies at regional and national levels.

References

1. World Health Organization. WHO consultation to develop a strategy to estimate the global burden of foodborne diseases. Geneva: World Health Organization; 2006. ISBN 978 92 4 159529 2 p. vii. Available at: http://www.who.int/foodsafety/publications/ foodborne_disease/fbd_2006.pd
2. Murray CJ, Lopez AD, Jamison DT. The global burden of disease in 1990: summary results, sensitivity analysis and future directions. Bull World Health Organ. 1994;72(3):495-509. PMID: 8062404; PMCID: PMC2486716.
3. Pires SM, Desta BN, Mughini-Gras L, Mmbaga BT, Fayemi OE, Salvador EM, Gobena T, Majowicz SE, Hald T, Hoejskov PS, Minato Y, Devleesschauwer B. Burden of foodborne diseases: think global, act local. Curr Opin Food Sci. 2021 Jun;39:152-159. doi: 10.1016/j.cofs.2021.01.006. PMID: 34178607; PMCID: PMC8216060.
4. Havelaar AH, Kirk MD, Torgerson PR, Gibb HJ, Hald T, Lake RJ, Praet N, Bellinger DC, de Silva NR, Gargouri N, et al. World Health Organization Foodborne Disease Burden Epidemiology Reference Group. World Health Organization Global Estimates and Regional Comparisons of the Burden of Foodborne Disease in 2010. PLoS Med. 2015 Dec 3;12(12):e1001923. doi: 10.1371/journal.pmed.1001923. PMID: 26633896; PMCID: PMC4668832.
5. Pires SM, Desta BN, Mughini-Gras L, Mmbaga BT, Fayemi OE, Salvador EM, et al. Burden of foodborne diseases: think global, act local. Curr Opin Food Sci. 2021;39:152-159. doi: 10.1016/j.cofs.2021.01.006. PMID: 34178607; PMCID: PMC8216060
6. WHO: First Formal Meeting of the Foodborne Disease Burden Epidemiology Reference Group (FERG): Implementing Strategy, Setting Priorities And Assigning The Tasks. 2008. ISBN: 978-92-4-159676-3.
7. WHO: Workshop Report: National Workshop on Foodborne Disease Surveillance and Response; Hai Phong, Vietnam, 9-11 August 2016: 2016
8. WHA: Seventy Third World Health Assembly (WHA 73.5). Agenda Item 15.3. Strengthening Efforts on Food Safety; 3 August 2020: 2020.
9. World Health Organization. WHO estimates of the global

burden of foodborne diseases: foodborne disease burden epidemiology reference group 2007-2015. World Health Organization; 2015 ISBN: 978-92-4-156516-5

10. European Food Safety Authority, European Centre for Disease Prevention and Control.

The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2014. Parma: European Food Safety Authority; 2016

https://doi.org/10.2903/j.efsa.2016.4634

11. EFSA explains zoonotic diseases: food-borne zoonoses. Parma: European Food Safety Authority; 2014 (https://www.efsa.europa.eu/sites/default/files/corporate_publications/files/factsheetfoodbornezoonoses2014_

12. EFSA and ECDC (European Food Safety Authority and European Centre for Disease Prevention and Control), 2021. The European Union One Health 2019 Zoonoses Report. EFSA Journal 2021;19(2):6406, 286 pp. https://doi.org/10.2903/j.efsa.2021.6406

13. Kumagai Y, Gilmour S, Ota E, Momose Y, Onishi T, Bilano VL, Kasuga F, Sekizaki T, Shibuya K. Estimating the burden of foodborne diseases in Japan. Bull World Health Organ. 2015 Aug 1;93(8):540-549C. doi: 10.2471/BLT.14.148056. Epub 2015 Jun 1. Erratum in: Bull World Health Organ. 2015 Oct 1;93(10):740. PMID: 26478611; PMCID: PMC4581658.

14. World Health Organization. Estimating the burden of foodborne diseases: a practical handbook for countries: a guide for planning, implementing and reporting country-level burden of foodborne disease. World Health Organization; 2021, ISBN: 978-92-4-001226-4

15. Van Cauteren D, Le Strat Y, Sommen C, Bruyand M, Tourdjman M, Da Silva NJ, Couturier E, Fournet N, de Valk H, Desenclos JC. Estimated Annual Numbers of Foodborne Pathogen-Associated Illnesses, Hospitalizations, and Deaths, France, 2008-2013. Emerg Infect Dis. 2017 Sep;23(9):1486-1492. doi: 10.3201/eid2309.170081. PMID: 28820137; PMCID: PMC5572882.

16. EFSA. Salmonella . 2021. Достапно на: https://www.efsa.europa.eu/en/topics/topic/Salmonella

17. EFSA. Salmonella Cases No Longer Falling in the EU. 2017. Available at: https://www.efsa.europa.eu/en/press/news/171212

18. Simpson KMJ, Hill-Cawthorne GA, Ward MP, Mor SM. Diversity of Salmonella serotypes from humans, food, domestic animals and wildlife in New South Wales, Australia. BMC Infect Dis. 2018 Dec 5;18(1):623. doi: 10.1186/s12879-018-3563-1. PMID: 30518339; PMCID: PMC6280480.

19. USDA. Cost Estimates of Foodborne Illnesses. 2021. Available at: https://www.ers.usda.gov/data-products/cost-estimate-

sof-foodborne-illnesses.aspx

20. ECDC. Salmonella the Most Common Cause of Foodborne Outbreaks in the European Union. 2020. Достапно на: https: //www.ecdc.europa.eu/en/news-events/salmonella-most-common-cause-food-borne-outbreaks-european-union

21. Sundström K. Cost of Illness for Five Major Foodborne Illnesses and Sequelae in Sweden. Appl Health Econ Health Policy. 2018 Apr;16(2):243-257. doi: 10.1007/s40258-017-0369-z.

PUBLIC HEALTH

LEGAL REGULATION OF HEALTH SPECIALIZATIONS AND SUBSPECIALIZATIONS IN THE FIELD OF DENTISTRY IN THE REPUBLIC OF NORTH MACEDONIA

Vlatko Kokolanski[1], Kjiro Ivanovski[1], Julijana Nikolovska[1], Mira Jankulovska[1]

[1] *Faculty of Dentistry, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia*

Citation: Kokolanski V, Ivanovski Kj, Nikolovska J, Jankulovska M. Legal regulation of health specializations and subspecializations in the field of dentistry in the Republic of North Macedonia. Arch Pub Health 2024; 16 (1). 56:75.

doi.org/10.3889/aph.2024.6111

Key words: specializations, subspecializations, dentistry, legal regulation

***Correspondence:** Vlatko Kokolanski, Faculty of Dentistry, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia.

E-mail: vkokolanski@stomfak.ukim.edu.mk

Received: 27-Dec-2023; **Revised:** 8-Apr-2024; **Accepted:** 10-Apr-2024; **Published:** 01-Jul-2024

Copyright:©2024. Vlatko Kokolanski, Kjiro Ivanovski, Julijana Nikolovska, Mira Jankulovska. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

Competing Interests: The author have declared that no competing interests

Abstract

Recognizing the dynamic nature of changes in legal regulations governing health specializations and subspecializations in dentistry, the purpose of this paper was to present the current legal framework governing health specializations and subspecializations in dentistry in the Republic of North Macedonia. Materials and Methods: We conducted a comprehensive search of legal regulations accessible at the database of regulations and publications on the website of the Official Gazette of the Republic of North Macedonia, utilizing specific keywords, including „specializations," „subspecializations," and „dentistry." Additionally, we analyzed regulations available on the websites of higher education institutions offering specializations and subspecializations in dentistry. From the pool of regulations scrutinized, we selected those marked as valid or partially valid and relevant. Our study employed the legal-dogmatic method, content analysis, and the descriptive method. Results: The legal framework includes laws, regulations, decisions of the Government of the Republic of North Macedonia, decisions of higher education institutions, and government programs. Health workers in dentistry, regardless of their employment status, have the right to engage in specialization or subspecialization. The Ministry of Health can approve specialization or subspecialization for foreign citizens with completed dental faculty education. However, approval procedures vary depending on the employment status. Health workers with higher education in dentistry can specialize in 8 branches of specialization and 2 branches of subspecialization, conducted in accredited institutions. During the specialization and subspecialization, health workers are guided by a mentor and educators. In conclusion, frequent revisions in the legal framework governing health specializations and subspecializations in dentistry in the Republic of North Macedonia imply a recurrent re-norming process, potentially affecting healthcare workers' understanding of the legal framework surrounding specializations and subspecializations. Given the rapid scientific evolution, we advocate for reduced norming and alignment of higher education programs with emerging scientific insights.

ЈАВНО ЗДРАВЈЕ

ПРАВНА РЕГУЛАЦИЈА НА ЗДРАВСТВЕНИТЕ СПЕЦИЈАЛИЗАЦИИ И СУПСПЕЦИЈАЛИЗАЦИИ ОД ОБЛАСТА НА СТОМАТОЛОГИЈАТА ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА

Влатко Коколански[1], Ќиро Ивановски[1], Јулијана Николовска[1], Мира Јанкуловска[1]

[1] *Стоматолошки факултет, Универзитет „Св. Кирил и Методиј" во Скопје, Република Северна Македонија*

Извадок

Препознавајќи ја динамичната природа на промените во законските прописи кои ги регулираат здравствените специјализации и супспецијализации во стоматологијата, целта на овој труд беше да ја претстави актуелната правна рамка што ги регулира здравствените специјализации и супспецијализации по стоматологија во Република Северна Македонија. Материјали и методи: Спроведовме сеопфатно пребарување на правните прописи достапни преку базата на прописи и изданија на веб-страницата на ЈП „Службен весник на Република Северна Македонија", користејќи специфични клучни зборови, вклучувајќи: „специјализации", „супспецијализации" и „стоматологија". Дополнително, ги анализиравме прописите достапни на веб-страниците на високообразовните институции кои спроведуваат специјализации и супспецијализации во стоматологијата. Од сите прописи што беа разгледани, ги избравме оние кои беа означени како важечки или делумно важечки и релевантни. Нашето истражување го користеше правно-догматскиот метод, анализа на содржината и дескриптивниот метод. Резултати: Правната рамка вклучува закони, прописи, одлуки на Владата на Република Северна Македонија, одлуки на високообразовни институции и владини програми. Здравствените работници во стоматологијата, без разлика на работниот статус, имаат право да започнат со специјализација или супспецијализација. Министерството за здравство може да одобри специјализација или супспецијализација за странски државјани со завршен стоматолошки факултет. Сепак, процедурите за одобрување се разликуваат во зависност од работниот статус. Здравствените работници со високо образование од стоматологија можат да специјализираат во 8 гранки на специјализација и 2 гранки на супспецијализација, спроведени во акредитирани институции. За време на специјализацијата и супспецијализацијата, здравствените работници се раководени од ментор и едукатори. Како заклучок, честите ревизии во правната рамка што ги регулира здравствените специјализации и супспецијализации во стоматологијата во Република Северна Македонија подразбираат повторлив процес на ренормирање, што потенцијално може да влијае на разбирањето на здравствените работници на правната рамка за специјализациите и супспецијализациите. Со оглед на брзата научна еволуција, ние се залагаме за намалено нормирање и усогласување на програмите за високо образование со новите научни сознанија.

Цитирање: Коколански В, Ивановски Ќ, Николовска Ј, Јанкуловска М. Правна регулација на здравствените специјализации и супспецијализации од областа на стоматологијата во Република Северна Македонија. Арх Ј Здравје 2024;16 (1) 56:75.

doi.org/10.3889/aph.2022.6111

Клучни зборови: специјализации, супспецијализации, стоматологија, правна регулација

***Кореспонденција:** Влатко Коколански, Универзитет „Св. Кирил и Методиј" во Скопје, Стоматолошки факултет, Северна Македонија.

E-mail: vkokolanski@stomfak.ukim.edu.mk

Примено:27-дек-2023; **Ревидирано:**8-апр-2024; **Прифатено:** 10-апр-2024; **Објавено:** 01-јули-2024

Печатарски права: ©2024. Влатко Коколански, Ќиро Ивановски, Јулијана Николовска, Мира Јанкуловска. Оваа статија е со отворен пристап дистрибуирана под условите на нелокализирана лиценца, која овозможува неограничена употреба, дистрибуција и репродукција на било кој медиум, доколку се цитираат оригиналниот(ите) автор(и) и изворот.

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Introduction

Specialization in dentistry is crucial for any country, serving its primary functions - providing a solid dental educational foundation, meeting the needs of specific patients, responding to the complex societal needs on behalf of the dental profession, and addressing the growth needs of individual dentists[1].

The General Assembly of the FDI World Dental Federation in 2012 provided a definition of Dental Specialization. According to the FDI, Dental Specialization entails formal acquisition, ongoing maintenance, and continual improvement of comprehensive knowledge and experience-based competencies by a dentist in a specific discipline (specialty) of dentistry[2].

In Yugoslavia, prior to 1941, individuals could attain the title of dentist - specialist in diseases of the mouth and teeth upon completion of general medicine studies, followed by a mandatory two-year internship, additional two-year training, and a specialized theoretical and practical exam conducted by a commission formed within individual regional administration. However, legal provisions did not regulate further specialization in specific dental disciplines, leading to the emergence of unrecognized specialists in fields such as orthodontics[3].

Following the country's liberation, Yugoslavia faced a significant shortage of professional personnel, particularly in oral healthcare. As a result, accelerated training programs for dental personnel were initiated. However, the training process was largely unplanned, resulting in the establishment of various educational centers ranging from secondary dental schools to higher education institutions. Consequently, the post-war period saw a diverse range of differently trained dental professionals, with limited opportunities for specialization. While sporadic specializations occurred, primarily following the pre-1941 model, wherein general medical doctors could undergo three-year specialization programs, the absence of dedicated dental faculties or departments limited formalized specialization avenues. Nonetheless, individuals within university settings focused on specific dental professions, expanding their theoretical knowledge, conducting professional and scientific research, and contributing to staff education, effectively becoming ipso facti unrecognized experts in certain dental specialties[3].

The legal framework governing specializations in dentistry within the former Yugoslavia originated from 1959 with the adoption of two key regulations. The first was the Rulebook on specialization branches and the duration of specialist experience for health officials[4], followed by the Rulebook on specialization for health officials of the first group the subsequent year[5].

These rulebooks delineated two potential areas of specialization in dentistry: jaw orthopedics with prosthetics and maxillofacial surgery. However, both specializations encountered implementation challenges. It was observed that dentists with specialized training but limited general medical knowledge were not considered suitable candidates

for maxillofacial surgery specialization. Similarly, the intended implementation of specialization in jaw orthopedics with prosthetics faced obstacles. Consequently, the outcome was the emergence of several specialists in maxillofacial surgery who had completed comprehensive medical education. Additionally, others specialized in jaw and teeth orthopedics (orthodontics)[3].

In Yugoslavia, where the dental profession had attained a high level due to the presence of educational state centers, there was a considerable discourse within professional, social, and political circles regarding the necessity for revising specialization in dentistry. Stakeholders sought proposals for new legal frameworks that would modernize and legislate this issue in a manner more aligned with the contemporary stage of dentistry, the requirements of specialist personnel, societal needs, and available opportunities. In response to this need for reform, Lapter and Njemirovskij advocated for the introduction of three specialized fields: orthodontics, oral surgery, and general dentistry. They proposed maxillofacial surgery, as a cross-disciplinary domain encompassing both dentistry and medicine, to be reserved for graduate doctors[3].

Following an extensive period of deliberation, the Regulation on the specialization of doctors, dentists, and graduated pharmacists was enacted6, based on the Law on Health from 1970[7]. This regulation specified the permissible areas of specialization for dentists, including diseases of the mouth and teeth, oral surgery, orthopedics of the jaws with children's and preventive dentistry, and dental prosthetics. The duration of specialist internships across all branches was set at three years. Furthermore, the regulation outlined pathways for further specialization, stipulating that doctors specializing in surgery could pursue additional training in the narrower field of maxillofacial surgery, while dentists specializing in oral surgery could also pursue training in maxillofacial surgery. A minimum period of seniority, one year for doctors and two years for dentists, was established for each of these narrower specialties. The regulation also included provisions for specialization plans across all branches.

In 1984, pursuant to the Law on Health Care, adopted in 1983[8], the State Committee for Health and Social Policy, building upon previous recommendations from the State Community for Health Care and the input from the Faculty of Medicine, Dentistry, and Pharmacy, promulgated the Rulebook on Specialization and Subspecialization of Health Workers and Health Associates with Higher Education[9]. This Rulebook delineated nine branches of dentistry in which health workers graduating from the Faculty of Dentistry could specialize: 1) Oral and periodontal diseases, 2) Dental and endodontic diseases, 3) Pediatric and preventive dentistry, 4) Maxillofacial surgery, 5) General dentistry, 6) Oral surgery, 7) Jaw orthopedics, 8) Dental prosthetics, 9) Social medicine with organization and economics of health care. Each specialization had a duration of 36 months, except for maxillofacial surgery, which required 60 months. Notably, the Rulebook did not provide for subspecializations

within dentistry; however, it did afford otorhinolaryngology specialists the opportunity to subspecialize in maxillofacial surgery for a duration of 24 months.

In 1991, the Law on Health Care was enacted, granting health workers the authority to specialize and subspecialize in specific branches of dentistry. The details regarding the branches of specializations and subspecializations, their durations, and the components of their internships were to be determined by the Ministry of Health, following consultation with the relevant higher education organization responsible for prescribing plans and programs. These determinations were to be conducted in accordance with regulations governing postgraduate studies[10].

During the period of the law's implementation, three regulations were introduced to govern specializations and subspecializations: 1) the Regulation on specialization and subspecialization of health workers and health associates with higher education, initially adopted in 1992 and subsequently amended and supplemented several times[11]; 2) the Rulebook on specializations and sub-specializations of health workers and healthcare workers with higher education, enacted in 2006([12]); 3) the Rulebook on specializations and subspecializations of healthcare workers and healthcare workers with higher education, established in 2011[13].

The 1992 Regulation specified that health workers who had completed dental school could specialize in various branches of dentistry, including: 1) oral and periodontal diseases, 2) dental and endodontic diseases, 3) pediatric and preventive dentistry, 4) maxillofacial surgery, 5) oral surgery, 6) orthopedics of the jaws, 7) dental prosthetics, and 8) social medicine with the organization of health activity. The duration of these specializations was set at 36 months, except for maxillofacial surgery, which required 48 months of training. Health workers with a completed medical degree, following specialization experience and successful completion of a specialist exam in otorhinolaryngology and general surgery, were eligible to pursue subspecialization in maxillofacial surgery in duration of 24 months[11].

The Rulebook on specializations and subspecializations of healthcare workers and healthcare associates with higher education, enacted in 2006, outlined the following branches of dentistry available for specialization, along with their respective durations: 1) Pediatric and preventive dentistry – 36 months, 2) Maxillofacial surgery – 48 months, 3) Oral surgery – 36 months, 4) Orthodontics – 36 months, 5) Dental prosthetics – 36 months, 6) Reconstructive dental dentistry – 24 months, 7) Endodontics – 24 months, 8) Periodontology – 24 months, 9) Oral medicine and pathology – 24 months, 10) Primary dental health care – 24 months. Additionally, the Rulebook allowed healthcare workers with a completed medical degree, after fulfilling specialization experience and successfully passing a specialist exam in otorhinolaryngology and general surgery, to pursue subspecialization in maxillofacial surgery in duration of 24 months. Furthermore, the Rulebook provided avenues for subspecial-

izations within certain branches of dentistry: specialists in pediatric and preventive dentistry or dental prosthetics could subspecialize in pediatric prosthetics, specialists in oral surgery, dental prosthetics, or periodontology could subspecialize in oral implantology, specialists in dental prosthetics could subspecialize in reconstructive maxillofacial prosthetics. The duration of these subspecializations varied: pediatric prosthetics and oral implantology lasted for 12 months, and reconstructive maxillofacial prosthetics lasted for 6 months[12].

The regulations of 2011 introduced nine specializations in dentistry, each with its respective duration: 1) Pediatric and preventive dentistry - 36 months, 2) Maxillofacial surgery - 48 months, 3) Oral surgery - 36 months, 4) Orthodontics - 36 months, 5) Dental prosthetics - 36 months, 6) Endodontics and restorative dentistry – 36 months, 7) Periodontology – 36 months, 8) Oral medicine – 36 months, 9) Primary dental health care – 24 months. Additionally, specialists in dentistry were permitted to pursue subspecializations in the following narrower specialties, each with its own duration: 1) Oral implantology – 24 months, 2) Pediatric prosthetics – 12 months, 3) Reconstructive maxillofacial prosthetics – 12 months. Moreover, healthcare workers who had graduated from a Faculty of Medicine, upon completing specialization and passing a specialist exam in otorhinolaryngology and general surgery, were eligible to subspecialize in maxillofacial surgery in duration of 24 months[13].

Recognizing the dynamic nature of changes in legal regulations governing health specializations and subspecializations in dentistry, the purpose of this paper emerged: to present the current positive and valid legal framework governing health specializations and subspecializations in the field of dentistry in the Republic of North Macedonia.

Materials and Methods

In order to achieve the defined objective, we conducted a comprehensive search of legal regulations accessible at the database of regulations and publications on the website of the Official Gazette of the Republic of North Macedonia. Our search utilized specific keywords, including "specializations," "subspecializations," and "dentistry." Additionally, we analyzed regulations available on the websites of higher education institutions that offer specializations and subspecializations in dentistry. From the pool of regulations scrutinized, we selected those marked as valid or partially valid and relevant to specializations and subspecializations in dentistry.

In our study, we employed the following methodologies: legal-dogmatic method, content analysis and descriptive method.

Results

1. Legal Framework of Specializations and Subspecializations

The valid legal framework regulating specializations and subspecializations in the field of dentistry comprises legal regulations summarized in Table 1.

Table 1 Overview of Legal Framework of Specializations and Subspecializations in the Field of Dentistry

1. Law:
- The Health Care Act ([14])
2. Regulations:
- Rulebook on specializations and sub-specializations of health workers and health associates with higher education in the field of dentistry and pharmacy[15]
- Rulebook on the method of recognition and the necessary documentation for the recognition of specializations and subspecializations completed abroad, as well as the method of keeping records of recognized specializations and subspecializations completed abroad[16]
3. Decisions of the Government of the Republic of North Macedonia:
- Decision on the compensation for conducting theoretical teaching and practical training and for taking an exam for specializations, i.e. subspecializations in the field of medicine, dentistry, and pharmacy[17]
4. Decisions of higher education institutions:
- Decision on determining criteria for selection of candidates, procedure for registration of specialization, procedure and conditions for changing the branch of specialization, adopted by Ss. Cyril and Methodius University in Skopje, Faculty of Dentistry – Skopje[18]
- Decision on determining criteria for candidate selection, procedure for registration of subspecialization, procedure for approval of subspecialization, and conditions for changing the branch of subspecialization, adopted by Ss. Cyril and Methodius University in Skopje, Faculty of Dentistry – Skopje[19]
5. Government programs
The program for the needs of specialist and subspecialist personnel in accordance with the network of health institutions (2023 - 2026)[20]

2. Eligibility for specialization and subspecialization

The right to pursue specialization and subspecialization in the field of dentistry is outlined in the Law on Health Care[14]. According to this legislation, health workers within the realm of dentistry are entitled to pursue specialization and subspecialization in specific branches of dentistry. The Minister of Health prescribes the delineation of these branches, their respective durations, components of the specialization practical sessions, plans and programs, as well as the procedures for conducting this experience, examination methods, and documentation requirements, including the format of specialization records. This prescription occurs subsequent to obtaining the prior opinion of the relevant higher education institution, in conjunction with the corresponding chambers[14].

Health workers operating in the field of dentistry, whether employed in public health institutions, private health institutions, other legal entities, or currently unemployed, possess the right to engage in specialization or subspecialization. Furthermore, the Ministry of Health is empowered to approve specialization or subspecialization for foreign citizens who are health workers with completed dental faculty education.

2.1. Procedure for approval of specializations and subspecializations of doctors of dentistry employed in public health institutions

The Government of the Republic of North Macedonia has adopted a comprehensive four-year program designed to address the specific personnel requirements for specialists and subspecialists in alignment with the established network of health institutions. Within this program, the determination of specialist and subspecialist personnel needs is conducted on an annual basis, having in mind factors such as the existing number and demographic distribution of specialists, as well as the waiting time recorded in the electronic list of scheduled examinations and interventions. Furthermore, the program accounts for the demand for specialist-consultative and hospital health services within the respective municipality or public health facility. Ultimately, the adoption of the program occurs by the endorsement of the Council for Specializations, a body appointed by the Minister of Health[14].

Based on the aforementioned program, healthcare facilities within the network develop a professional advancement plan. The planning and approval of specialization or subspecialization for healthcare professionals are restricted to the specific branches of dentistry constituting the activities of the healthcare institution and its legal entity. Referral to specialization or subspecialization is overseen by healthcare institutions providing care, following procedures stipulated in their governing documents. Once referred, documentation verifying the fulfillment of prerequisites and approval of specialization or subspecialization in accordance with the professional advancement plan is submitted by the healthcare institution to the higher education institution for registration purposes.

Subsequently, the public health institution endorsing the subspecialization enters into an agreement with the subspecialist, outlining mutual rights and obligations regarding the realization of the subspecialization. This agreement delineates the period during which the subspecialist is obliged to serve in the institution post-completion of the subspecialization, along with provisions for financial compensation in the event of premature departure at the subspecialist's request or due to their fault, alongside suitable guarantees for non-fulfillment of obligations towards the health institution[14].

2.2. Procedure for approval of specializations and subspecializations of doctors of dentistry employed in private health institutions, other legal entities and unemployed

Healthcare workers, including health associates employed in private health institutions, other legal entities, and those currently unemployed, are eligible to apply for enrollment in specialization or subspecialization programs. These programs must align with the specialization plan endorsed by the higher education institution and require applicants to satisfy the conditions outlined in the Law on Health Care, along with additional criteria established by the higher education institution. Specifically, in accordance with the Health Care Law, dentists must have completed a probationary period, passed a professional exam, and obtained a work license. Conversely, health workers with a medical education background may pursue spe-

cialization provided they fulfill the aforementioned requirements and possess at least six months of experience in primary health care within a health center, as per the Ministry of Health's program guidelines[14].

Each higher education institution develops its own regulations governing the selection process for candidates, registration procedures for specialization or subspecialization, approval procedures for specialization or subspecialization, and conditions for transitioning between specialization or subspecialization branches[14].

Based on our findings, it appears that only decisions made by the Faculty of Dentistry - Skopje, a constituent part of Ss. Cyril and Methodius University in Skopje, are recognized. Acts passed by the Faculty of Medical Sciences at the "Goce Delchev" University in Shtip are not considered valid in this context.

The higher education institution issues a public announcement for the registration of candidates seeking approval for specialization or subspecialization. This announcement is published in at least two daily newspapers, providing an opportunity for health workers employed in private health institutions, other legal entities, and those currently unemployed to submit their requests for approval of specialization or subspecialization. Requests must be submitted to the higher education institution within 30 days from the date of publication of the public notice[15].

Upon receiving the decision for approval, issued no later than two months from the publication date of the public announcement, health care workers employed in private health care facilities and unemployed health care workers commence their specialist or subspecialist internships. The selection of candidates is based on a ranking list, and those who receive approval enter into an agreement with the higher education institution to establish mutual rights and obligations throughout the duration of the specialization program.

Unlike specializations, the Law on health care does not stipulate prerequisites for subspecialization registration; however, the conditions are outlined in the Regulation on Specializations and Subspecializations of Health Workers and Health Associates with Higher Education in the Field of Dentistry and Pharmacy[15]. According to this egulation, healthcare workers with higher education in dentistry who have completed a specialization internship and passed a specialist exam in one of the branches of dentistry can pursue subspecialization in up to two narrower subspecialties[15].

3. Branches of Specializations and Subspecializations in the Field of Dentistry

The Minister of Health, following a prior opinion of the corresponding higher education institution and in collaboration with the relevant chambers, prescribes the branches of specializations and subspecializations[14].

The Rulebook on Specializations and Subspecializations of Health Workers and Health Associates with Higher Education in the Field of Dentistry and Pharmacy[15] serves as

the authoritative document governing the branches of specializations and subspecializations for health workers with higher education in dentistry. This by-law prescribes the duration of these specializations, the components of specialization experience, and the criteria - both organizational and personnel-related - that must be met by higher education institutions and health institutions. Additionally, it delineates the form and content of written authorizations for implementing theoretical and practical aspects of specialization internships, along with plans, programs, and procedures for carrying out the internships and taking the specialist or subspecialist exams. The Rulebook also specifies the format for specialist and record books documenting procedures and interventions during specialization and subspecialization internships, as well as the required forms for minutes-keeping and certificates for passing specialist or subspecialist exams. Moreover, it outlines criteria pertaining to education and experience for relevant fields of specialization or subspecialization for authorized health workers, including mentors and educators.

According to the Rulebook, health workers with higher education in dentistry can specialize in the branches of specialization as outlined in Table 2.

Table 2 Branches of specializations in the field of dentistry

Branch of specialization	Duration
Dental prosthetics	36 months
Orthodontics	36 months
Oral surgery	36 months
Maxillofacial surgery	72 months
Periodontology	36 months
Oral medicine	36 months
Endodontics with restorative dentistry	36 months
Children's and preventive dentistry	36 months

The subspecializations, their duration and the conditions for which specialists can subspecialize are presented in Table 3.

Table 3 Narrower subspecialties in the field of dentistry

Subspecialization	Duration	Requirement for enrolling in the subspecialization program
Oral implantology	24 months	Completed specialization in oral surgery, dental prosthetics, periodontology or maxillofacial surgery.
Endodontics with endodontic surgery	24 months	Completed specialization in the field of endodontics and restorative dentistry or oral surgery

The duration specified for specialization and subspecialization, as outlined in the regulations, represents the minimum period within which the specialist or subspecialist is expected to complete all aspects of the internship. It is possible for specialization or subspecialization to extend beyond the planned duration until the specialist has completed all anticipated procedures and interventions detailed in the Work Log recording the latter. This extension is contingent upon the specialist acquiring the requisite knowledge and skills during the internship, as outlined in the plan and program. The programs for specializations and subspecializations include a segment common to all specialist or subspecialist programs, comprising theoretical instruction in the following areas: scientific and research methodologies, clinical decision-making, communication skills, public health principles, knowledge acquisition and dissemination techniques, ethical considerations and regulations, and health promotion strategies[15].

4. Institutions providing/delivering specialization and subspecialization programs

As stipulated in the Health Care Law, specialization and subspecialization programs are conducted in higher education institutions and health institutions accredited by the Minister of Health, operating on a full-time basis and adhering to the provisions stipulated in the forestated Law and associated regulations.

The theoretical component of specialization and subspecialization programs, i.e., subspecialization for health workers in dentistry is delivered by accredited higher education institutions. These institutions must meet specific criteria outlined in accordance with relevant rulebook regarding organization, personnel, facilities, and medical-technical resources ([15]). Accredited higher education institutions in the Republic of North Macedonia authorized to conduct specializations and subspecializations in dentistry include Ss. Cyril and Methodius University in Skopje, Faculty of Dentistry – Skopje, and Faculty of Medical Sciences at "Goce Delchev" University in Shtip.

Health facilities where the practical component of specialization or subspecialization is conducted must also meet specific criteria established by the Rulebook ([15]), encompassing aspects such as organization, personnel, space, and medical-technical resources. Accredited health institutions in the field of dentistry in the Republic of North Macedonia include the PHI University Dental Clinical Center, "St. Panteleimon" in Skopje, and the PHI University Clinic for Surgery of the Face, Jaws, and Neck - Maxillofacial Surgery "Academician Ilija Vaskov" in Skopje. Additionally, part of the practical training may take place in other public health institutions, contingent upon agreements reached between the higher education institution and the respective health institution.

5. Method of implementation of specializations and subspecializations

The commencement of specialization or subspecialization occurs on the specified date indicated in the decision for approval issued by the higher education institution. The

implementation of the specialization or subspecialization program proceeds continuously, except in circumstances defined by the Law on Health Care, where interruptions may occur, with subsequent resumption following the conclusion of the leave period for a duration equivalent to the interruption. Specialization and subspecialization entail a combination of theoretical instruction and practical training, conducted over a designated period within corresponding higher education and health institutions[15].

It's imperative for trainees, including subspecialists, to fulfill tasks outlined in the preceding practical sessions and program in order to qualify for registration in the subsequent one. A colloquium is undertaken by specialists or subspecialists no later than one month following the conclusion of each practical sessions. The specialization or subspecialization internship culminates upon the successful completion of all practical sessions as per the established program and the execution of all prescribed procedures and interventions throughout the internship duration[15].

The rights and responsibilities of interns during specialization internships, as well as the tasks performed in accordance with the specialization program, are deemed equivalent to professional duties within a workplace. The intern bears personal and disciplinary responsibility for the execution or non-execution of assigned tasks.

6. Record of Specialization and Subspecialization Implementation

The documentation stemming from the execution of specializations and subspecializations, mandatory for each specialist or subspecialist, includes:

- Specialized Record book
- Work Log detailing procedures and interventions conducted during specialization and subspecialization experiences.

The format and content of the record book and the Work Log for procedures and interventions carried out during specialization internships are prescribed by a governing by-law[15].

During the specialist internship, adherence to the plan and program for specialization is paramount. All pertinent details are meticulously recorded in the specialized record book, ensuring accuracy and completeness. This includes precise documentation of the commencement and conclusion of the specialist internship, as well as the timing of each internship segment or practical sessions. Additionally, the specialization book captures information regarding procedures performed as outlined in the corresponding specialization segment, along with competencies and skills attained in accordance with the program. The specialist's attendance in theoretical teaching sessions, as per program requirements, is also recorded. Upon completion of the specialist internship, the mentor provides an assessment of the intern's performance and confirms fulfillment of conditions for specialist exam eligibility[15].

The procedures and interventions executed throughout the specialization are meticulously

documented in the Work Log for Implemented Procedures and Interventions during the internship. This book ensures accurate and comprehensive data entry, particularly regarding the practical sessions title, procedure or intervention type, date, and the health facility where the procedure was conducted. Additionally, it specifies whether the procedure was carried out independently or under supervision. It is imperative for the procedures and interventions logged in the Work Log to align precisely with the specialization program content[15].

Upon completion of each practical sessions, the mentor, educator, and director of the health facility where the practical sessions took place endorse the Specialized record book and the Work Log for Implemented Procedures and Interventions. Their signatures and facsimiles attest to the accuracy and completeness of the entries therein[14].

7. The Role of a Mentor and Educator in Specializations and Subspecializations

7.1. Mentor

The organization and supervision of the plan and program for specializations and subspecializations are overseen by an accredited health professional, known as a mentor. This mentor must possess the requisite education and experience in the relevant specialization or subspecialization area. Throughout the implementation of the specialization or subspecialization program, the mentor assumes additional responsibilities, collaborating with an authorized health worker, known as an educator, to facilitate the trainee's acquisition of skills outlined in the program. Together, they ensure the trainee's successful mastery of knowledge and skills during the specialization or subspecialization. The mentor must be employed at the higher education institution conducting the specialization or subspecialization, with authorization granted by the Minister of Health[15].

During the specialization or subspecialization internship, the mentor oversees its proper execution, monitors the trainee's progress, assesses his/her knowledge and skill mastery, verifies the accuracy of data recorded in the trainee's booklet, and provides guidance to the trainee until he/she successfully passes the specialist or subspecialist exam[15].

The mentor confirms the successful mastery of each part of the specialization. This confirmation allows the trainee to progress further in the specialization or subspercialization program according to the plan and program. However, if the trainee fails to successfully master a particular part of the specialization or subspecialization, the duration of the specialization is extended to allow for additional time needed to attain competency in the corresponding part, known as a "repeated practical sessions." In such cases, the trainee may be required to repeat all or part of the practical sessions as deemed necessary by the mentor. The re-

sponsibility for implementing the repeated practical sessions or part thereof lies with the trainee[14].

Additionally, the mentor serves as a guide to the trainee throughout the specialization or subspecialization process, and one mentor can oversee up to six trainees simultaneously[14].

7.2. Educator

The acquisition and fulfillment of specific skills outlined in the plan and program for specializations or subspecializations are conducted by healthcare specialists within health facilities under the supervision of an accredited health professional, referred to as an educator. This educator must possess the requisite education and experience in the relevant specialization or subspecialization area (14). The authorized health worker acting as an educator should be employed at the designated health facility where the practical component of specialization or subspecialization occurs, with authorization granted by the Minister of Health [15].

Specialists are permitted to perform certain tasks, or indicate them, within their specialized healthcare area, including subspecializing, but only under the supervision of the educator [14].

Furthermore, in collaboration with the mentor, one educator can oversee a maximum of three trainees during the parts of the specialization or subspecialization internship for which they are designated. He/she confirms the mastery and fulfillment of individual skills outlined in the plan and program for specializations or subspecializations [14].

Provisions for the revocation and termination of the mentor's and educator's authorization are outlined in the Health Care Law.

8. Financing of Specializations and Subspecializations

The compensation for the execution of specialization or subspecialization programs is established by the Government of the Republic of North Macedonia, based on recommendations from the Minister of Health. The relevant sublegislative measure governing this compensation is the Decision on Compensation for Theoretical Teaching, Practical Training, and Taking Exam for Specializations or Subspecializations in Medicine, Dentistry, and Pharmacy [17].

Furthermore, as outlined in the Law on Health Care, the compensation for specialization or subspecialization of healthcare workers employed in private health institutions, other legal entities, and the unemployed is set at 20% lower than the compensation provided to healthcare workers employed in public health institutions [14].

The total amounts of fees for carrying out the specialization, i.e. subspecialization, according to the branches of specialization, i.e. subspecialization and the different categories of specialists, i.e. subspecialists, is shown in Table 4.

Table 4 Total amount of fees for the implementation of the specialization, that is, the subspecialization

Branch of specialization	Persons employed in public health institutions	Persons employed in private health-care facilities, other legal entities and the unemployed	Foreign citizens
Dental prosthetics	5,000 euros	4,000 euros	12,000 euros
Orthodontics	5,000 euros	4,000 euros	12,000 euros
Oral surgery	5,000 euros	4,000 euros	12,000 euros
Maxillofacial surgery	8,000 euros	6,400 euros	16,000 euros
Periodontology	3,000 euros	2,400 euros	9,000 euros
Oral medicine	3,000 euros	2,400 euros	9,000 euros
Endodontics with restorative dentistry	3,000 euros	2,400 euros	9,000 euros
Children's and preventive dentistry	3,000 euros	2,400 euros	9,000 euros
Branch of subspecialization			
Oral implantology	3,000 euros	2,400 euros	6,000 euros
Endodontics with endodontic surgery	3,000 euros	2,400 euros	6,000 euros

The higher education institution retains 50% of the compensation funds allocated for each individual specialist or subspecialist for the execution of their specialization or subspecialization. The remaining 50% of these funds are then distributed and disbursed to the respective public health institutions where the specific skills outlined in the plan and program for specializations or subspecializations are mastered and fulfilled. This distribution is facilitated through pre-existing agreements between each public health institution and the higher education institution[14].

It is mandated by law that both the higher education institution and the health institution utilize the funds received for the implementation of specialization or subspecialization to foster the advancement of higher education or healthcare activities, respectively. Additionally, these funds are earmarked for compensating mentors and educators, as well as for conducting language proficiency assessments for specialists[14].

9. Passing the Specialist or Subspecialist Exam

Following the completion of all procedures and interventions outlined in the plan and program for specialization or subspecialization, and preceding the specialist or subspecialist exam, the specialist or subspecialist is required to undergo a pre-examination final colloquium. This colloquium serves as a prerequisite for the specialist or subspecialist exam. The specialist or subspecialist exam must be taken no later than six months from the conclusion of the specialization or subspecialization internship. To take

the exam, the specialist or subspecialist must submit an application to the higher education institution at least 30 days prior to the exam[15].

Both the pre-examination colloquium and the specialist or subspecialist exam are conducted by an examination committee assembled by the higher education institution. This committee comprises three members and an appropriate number of deputies. Notably, a member of the examination committee cannot serve as the mentor involved in the implementation of the specialist or subspecialist internship. However, the mentor can attend the exam[15].

Upon successfully passing the specialist or subspecialist exam, the trainee attains the professional designation of specialist in the relevant specialization branch or subspecialist in the relevant subspecialization branch. Additionally, the higher education institution issues a specialist certificate to the individual[15].

The Rulebook delineates various forms for documenting the specialist or subspecialist exam proceedings, as well as the issuance of specialist or subspecialist certificates. Moreover, it outlines conditions for exam completion and addresses potential scenarios if a specialist or subspecialist fails the exam[15].

Discussion

In 2012, a new Law on Health Care was enacted, which has been subsequently amended and supplemented multiple times and remains in effect[14]. In compliance with the legal regulations, in the same year, the Rulebook on specializations and subspecializations of health workers and health associates with higher education[21] was issued, which provided for specializations and subspecializations across all fields of medicine, dentistry, and pharmacy. This Rulebook retained the same specializations and subspecializations as those outlined in the 2011 Rulebook.

In 2019, a new Rulebook was enacted on specializations and sub-specializations of healthcare workers with higher education in the field of dentistry and pharmacy, as well as healthcare associates with higher education[22]. This Rulebook exclusively regulated specializations for health workers with higher education in dentistry and pharmacy, considering that in 2015, a separate Rulebook had been adopted to regulate specializations and subspecializations for health workers with higher education in the field of medicine[23]. The 2019 Rulebook maintained the same specializations and subspecializations as its predecessors from 2011 and 2012. However, an amendment was made to the 2019 Rulebook in the same year, specifically regarding the duration of specialization in maxillofacial surgery. Initially set at 48 months, the amendment extended this duration to 60 months.

Two years later, in 2021, another new Rulebook was adopted on specializations and subspecializations of healthcare workers and healthcare associates with higher education in the field of dentistry and pharmacy[15], which remains in effect.

In 2012, a Rulebook was adopted regarding the method of calculat-

ing the weighting of points based on the average success of candidates achieved in higher education and their success in subjects relevant to the specialization area. This Rulebook, along with its amendment in 2022, was adopted by the Minister of Health. However, it has not been published in the "Official Gazette of the Republic of North Macedonia". This lack of publication contradicts Article 52 of the Constitution[24], which stipulates the obligation to publish laws and other regulations in the "Official Gazette of the Republic of North Macedonia". Additionally, it is not in line with the Law on the publication of laws and other regulations and acts in the "Official Gazette of the Republic of North Macedonia"[25].

Furthermore, in our study, based on the available data from official web pages, no decisions were found from the higher education institution "Goce Delchev" University in Shtip that regulate specializations and subspecializations. This indicates the lack of transparency of certain higher education institutions that provide health specializations in the field of dentistry.

It is important to note that the procedure for approving specialization or subspecialization differs depending on whether the individual is employed in a public health institution, private health institution, other legal entity, or is unemployed. These differing procedures are regulated by the Law on Health Care and its associated by-laws. Notably, the Law on health care does not specify the procedure for approving specialization or subspecialization for foreign citizens.

As delineated by the Law and the Rulebook[14,15], the responsibilities regarding the implementation of health specializations and subspecializations are divided between higher education institutions and health institutions. The higher education institution is tasked with overseeing the theoretical component of specialization and subspecialization programs, while the practical aspect is managed by the health institution. This legislative intent led to the allocation of distinct rights and obligations stemming from the approval and execution of specializations and subspecializations. Accordingly, the higher education institution issues decisions approving specializations or subspecializations, establishes agreements to regulate trainees' rights and obligations, appoints mentors, organizes theoretical instruction, and forms committees for conducting pre-examination final colloquia and specialist exams. Conversely, health institutions are responsible for appointing educators to facilitate the acquisition of individual skills outlined in the specialization program, which occurs during the provision of health services. Additionally, they maintain records of specialists' attendance and perform other related administrative tasks.

Although a total of 8 specializations in the field of dentistry are stipulated, only some of the specialists can subspecialize in narrower subspecialties. Namely, for specialists in the fields of orthodontics, oral medicine, and children's and preventive dentistry, there is no opportunity to pursue subspecialization in narrower subspecialties.

In the European Union and European Economic Area (EU/EEA) three member states have no recognized dental specialties and twelve have four or more. Orthodontics is recognized in most countries and oral surgery in over 60%. Other common specialties are periodontics and pedodontics. Variation in the numbers of specialties and specialists between individual countries is great and can partly be explained by oral health care systems and traditions to study abroad in some countries. Most existing specialties seem to have emerged from professional interests. Only two, orthodontics and oral surgery, are formally recognized by the European Commission (EC). The new Directive on recognition of professional qualifications has left the recognition of additional dental specialties to be negotiated between individual Member States. This calls for better Pan-European cooperation in dental matters in the future[26]. In 2023, the situation is similar. Namely, up to a total of 15 different specialties are officially recognized in 20 out of the 30 countries of which the European Economic Space plus the United Kingdom (UK). Orthodontics (90%) and Oral Surgery (81%) are the two most frequently recognized specialties[27].

The Minister of Health, following a prior opinion of the corresponding higher education institution and in collaboration with the relevant chambers, prescribes the branches of specializations and subspecializations, their durations, the components of specialization practical sessions, plans and programs, as well as the methods for conducting the experience, examination procedures, and the format of specialization and record books for procedures performed and interventions carried out during specialization internships14. Also, the compensation for the execution of specialization or subspecialization programs is established by the Government of the Republic of North Macedonia, based on recommendations from the Minister of Health. This indicates the increased control of the state regarding the regulation of health specializations in the field of dentistry, burdened with numerous legal acts.

Conclusions

In conclusion, an analysis of the gathered data has revealed frequent revisions in the legal framework governing health specializations and subspecializations in dentistry in the Republic of North Macedonia. These alterations in law and by-laws suggest a recurrent re-norming process, potentially resulting in healthcare workers' inadequate understanding of the legal framework regarding specializations and subspecializations. Given the rapid evolution of scientific knowledge in medicine and dentistry, we advocate for a reduction in excessive norming as well as for higher education institutions to adapt plans and programs in alignment with emerging scientific insights.

References

1. McCallum CA. Specialization in dentistry. Int Dent J 1978;28(4):398-405. PMID:282261
2. FDI World Dental Federation.

Specialization in Dentistry. Policy statement of the Dental Practice Committee adopted by the FDI General Assembly. Vienna (Austria). October 2012. Available online: https://www.fdiworlddental.org/resources/policy-statements-and-resolutions/specialization-in-dentistry (accessed on 20.12.2023).

3. Lapter, V. and Njemirovskij, Z. Specijalizacija u stomatologiji. Acta stomatologica Croatica 1966; 1 (1), 15-28.
4. Rulebook on specialization branches and the duration of specialist experience for health officials ("Official Gazette of the FNRJ", no. 24/59).
5. Rulebook on specialization for health officials of the first group the subsequent year ("Official Gazette of FNRJ", no. 2/60).
6. Regulation on the specialization of doctors, dentists, and graduated pharmacists ("Official Gazette of the SRM" no. 19/72 and 20/76).
7. Law on Health ("Official Gazette of the SRM", No. 20/70).
8. Law on Health Care ("Official Gazette of SRM" No. 10/83).
9. Rulebook on Specialization and Subspecialization of Health Workers and Health Associates with Higher Education ("Official Gazette of SRM", No. 36/84).
10. Law on Health Care ("Official Gazette of the Republic of Macedonia" number 38/91, 46/93, 55/95, 10/2004, 84/2005, 111/2005, 65/2006, 5/2007, 77/2008, 67/2009, 88/10, 44/11 and 53/11).
11. Regulation on the specialization and subspecialization of health workers and health associates with higher education, initially adopted in 1992 and subsequently amended and supplemented several times ("Official Gazette of the Republic of Macedonia" No. 1/92, 18/93, 53/95, 61/95, 59/96, 20/00, 20/02, and 2/04).
12. Rulebook on the specializations and sub-specializations of health workers and healthcare workers with higher education, enacted in 2006 ("Official Gazette of the Republic of Macedonia" no. 89/06).
13. Rulebook on the specializations and subspecializations of healthcare workers and healthcare workers with higher education, established in 2011 ("Official Gazette of the Republic of Macedonia" No. 61/11).
14. Law on Health Care ("Official Gazette of the Republic of Macedonia" number 43/12, 145/12, 87/13, 164/13, 39/14, 43/14, 132/14, 188/14, 10/15, 61/15, 154/15, 192/15, 17/16, 37/16 and 20/19 and "Official Gazette of the Republic of North Macedonia" number 101/19, 153/19, 180/19, 275/19, 77 /21, 122/21, 178/21, 150/22, 236/22, 199/23 and 263/23).
15. Rulebook on the specializations and subspecializations of healthcare workers and healthcare associates with higher education in the field of dentistry and pharmacy ("Official Gazette of the Republic of North Macedonia" number 275/21, 231/23).

16. Rulebook on the method of recognition and the necessary documentation for the recognition of specializations and subspecializations completed abroad, as well as the method of keeping records of recognized specializations and subspecializations completed abroad ("Official Gazette of the Republic of Macedonia" number 92/12).
17. Decision on the compensation for conducting theoretical teaching and practical training and for taking an exam for specializations, i.e. subspecializations in the field of medicine, dentistry, and pharmacy ("Official Gazette of the Republic of Macedonia" no. 123/12 and 124/15 and "Official Gazette of Republic of North Macedonia" no. 155/22).
18. Decision on determining criteria for selection of candidates, procedure for registration of specialization, procedure and conditions for changing the branch of specialization, adopted by the Ss. Cyril and Methodius University in Skopje Faculty of Dentistry - Skopje, registered under arch. no. 02-2446/3 from 03.10.2022. (Available at: https://stomfak.ukim.edu.mk Accessed on 25.12.2023).
19. Decision on determining criteria for candidate selection, procedure for registration of subspecialization, procedure for approval of subspecialization, and conditions for changing the branch of subspecialization, adopted by the Ss. Cyril and Methodius University in Skopje Faculty of Dentistry - Skopje, registered under arch. no. 02-1908/1 of 7/7/2023, (Available at: https://stomfak.ukim.edu.mk Accessed on 25.12.2023).
20. The program for the needs of specialist and subspecialist personnel in accordance with the network of health institutions (2023 - 2026) ("Official Gazette of the Republic of North Macedonia" no. 163/23 and 254/23).
21. Rulebook on the specializations and subspecializations of health workers and health associates with higher education ("Official Gazette of the Republic of Macedonia" no. 137/12 and 121/13)
22. Rulebook on the specializations and subspecializations of healthcare workers and healthcare associates with higher education in the field of dentistry and pharmacy ("Official Gazette of the Republic of Macedonia" number 28/19 and 206/19).
23. Rulebook on the specializations and subspecializations of health workers with higher education in the field of medicine, "Official Gazette of the Republic of Macedonia" no. 85/15).
24. Constitution of the Republic of Macedonia ("Official Gazette of the Republic of Macedonia" no. 52/91).
25. Law on the publication of laws and other regulations and acts in the "Official Gazette of the Republic of North Macedonia" (Official Gazette of the Republic of Macedonia" no. 56/99, 43/2002 and "Official Gazette of the Republic of North Macedonia" no. 21/21).

26. Widstrom E. Socio-economic factors guiding the number of dental specialists in Europe. European Journal of Dental Education 2006 ;10(2): 106–106. https://doi.org/10.1111/j.1396-5883.2006.00407_5.x

27. García-Espona I, García-Espona E, Alarcón JA et al. European inequalities and similarities in officially recognized dental specialties. BMC Oral Health 2023; 23: 280. https://doi.org/10.1186/s12903-023-02987-z

CLINICAL SCIENCE

ECONOMIC EVALUATION OF COST-EFFECTIVENESS IN EARLY VERSUS DELAYED LAPAROSCOPIC CHOLECYSTECTOMY IN ACUTE CHOLECYSTITIS

Rexhep Selmani[1], Qemal Rushiti[1], Andrea Nikolovski[2], Shaban Memeti[3], Arian Selmani[4]

[1] *University Clinic for Digestive Surgery; Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia*
[2] *University Clinic for Surgical Diseases St. Naum Ohridski; Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia*
[3] *University Clinic for Pediatric Surgery; Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia*
[4] *University Clinic for State Cardiac Surgery; Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Skopje, Republic of North Macedonia*

Citation: Selmani R, Rushiti Q, Nikolovski A, Memeti S, Selmani A. Economic evaluation of cost-effectiveness in early versus delayed laparoscopic cholecystectomy in acute cholecystitis. Arch Pub Health 2024; 16 (1). 76:86.

doi.org/10.3889/aph.2024.6124

Key words: acute cholecystitis, early laparoscopic cholecystectomy, hospital stay, hospital costs

***Correspondence:** Rexhep Selmani, University Clinic for Digestive Surgery; Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia.

E-mail: rselmani@live.com

Received: 5-Mar-2024; **Revised:** 10-Jun-2024; **Accepted:** 15-Jun-2024; **Published:** : 01-Jul-2024

Copyright:© 2024. J. Rexhep Selmani, Qemal Rushiti, Andrea Nikolovski, Shaban Memeti, Arian Selmani. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

Competing Interests: The author have declared that no competing interests

Abstract

Diseases of the biliary tree are prevalent in the gastrointestinal tract (GIT) and can have significant implications in terms of morbidity and mortality. Among these diseases, acute cholecystitis holds particular importance as it requires immediate attention and mandates timely diagnosis and appropriate treatment. Early laparoscopic cholecystectomy (LC) is a safe and effective procedure for managing acute cholecystitis, providing definitive treatment during the initial hospital stay and it is considered a superior option compared to delayed LC for the treatment of acute cholecystitis. The objective of the study was to examine the overall expenses incurred by hospitals and the duration of hospitalization concerning delayed laparoscopic cholecystectomy in patients diagnosed with acute cholecystitis. Materials and methods: An analytical (case-control) study was conducted involving 139 patients diagnosed with acute cholecystitis and admitted to the University Clinic for Digestive Surgery. Among them, 71 patients were assigned to the study group, while 68 patients were placed in the control group. Patients in the study group received early LC treatment within 0-7 days from the onset of symptoms, while patients in the control group underwent delayed LC treatment between 6-12 weeks from symptom onset. The selection of patients was made using a simple random selection method, following predetermined inclusion and exclusion criteria. Results: Among patients from both groups, there was no statistically significant distinction in age, gender, education, place of residence, past illnesses, comorbidity, and previous abdominal surgery for p>0.05. However, a notable dissimilarity existed between the groups regarding total costs, with significantly higher expenses observed during delayed treatment of patients with acute cholecystitis (t-test for independent samples=-37.644 df=137 p=0.0001). Conclusion: Significant variations were observed in total hospital length of stay and hospital costs between the two groups, indicating that laparoscopic treatment for acute cholecystitis was associated with higher expenses and longer hospital stays.

КЛИНИЧКИ ИСПИТУВАЊА

ЕКОНОМСКА ЕВАЛУАЦИЈА НА ТРОШОЦИ- ЕФЕКТИВНОСТ КАЈ РАНАТА НАСПРОТИ ОДЛОЖЕНА ЛАПАРОСКОПСКА ХОЛЕЦИСТЕКТОМИЈА КАЈ АКУТЕН ХОЛЕЦИСТИТ

Рецеп Селмани[1], Ќемал Рушити[1], Андреа Николовски[2], Шабан Мемети[3], Аријан Селмани[4]

[1] *Универзитетска клиника за дигестивна хирургија; Медицински факултет, Универзитет "Св. Кирил и Методиј" во Скопје, Република Северна Македонија*
[2] *Универзитетска клиника за хируршки болести Св. Наум Охридски; Медицински факултет, Универзитет "Св. Кирил и Методиј" во Скопје, Република Северна Македонија*
[3] *Универзитетска клиника за детска хирургија; Медицински факултет, Универзитет "Св. Кирил и Методиј" во Скопје, Република Северна Македонија*
[4] *Универзитетска клиника за државна кардиохирургија; Медицински факултет, Универзитет "Св. Кирил и Методиј" во Скопје, Скопје, Република Северна Македонија*

Цитирање: Селмани Р, Рушити Ќ, Николовски А, Мемети Ш, Селмани А. Економска евалуација на трошоци-ефективност кај раната наспроти одложена лапароскопска холецистектомија кај акутен холецистит. Арх Ј Здравје 2024;16 (1) 76:86.

doi.org/10.3889/aph.2022.6124

Клучни зборови: акутен холецистити, рана лапароскопска холецистектомија, престој во болница, болнички трошоци

***Кореспонденција:** Рецеп Селмани, Универзитетска клиника за дигестивна хирургија; Медицински факултет, Универзитет "Св. Кирил и Методиј" во Скопје, Република Северна Македонија.

E-mail: rselmani@live.com

Примено:5-мар-2024; **Ревидирано:**10-јун-2024; **Прифатено:** 15-јун-2024; **Објавено:** 01-јули-2024

Печатарски права: ©2024. Рецеп Селмани, Ќемал Рушити, Андреа Николовски, Шабан Мемети, Аријан Селмани. Оваа статија е со отворен пристап дистрибуирана под условите на нелокализирана лиценца, која овозможува неограничена употреба, дистрибуција и репродукција на било кој медиум, доколку се цитираат оригиналниот(ите) автор(и) и изворот.

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Извадок

Болестите на билијарното дрво се распространети во гастроинтестиналниот тракт (ГИТ) и може да имаат значителни импликации во однос на морбидитетот и морталитетот. Меѓу овие болести, акутниот холециститис има особено значење бидејќи бара итно внимание и бара навремена дијагноза и соодветен третман. Раната лапароскопска холецистектомија (LC) е безбедна и ефикасна процедура за управување со акутен холециститис, обезбедувајќи дефинитивен третман за време на почетниот престој во болница и се смета за супериорна опција во споредба со одложената LC за третман на акутен холециститис. Целта на студијата беше да се испитаат вкупните трошоци направени од страна на болниците и времетраењето на хоспитализацијата во врска со одложената лапароскопска холецистектомија кај пациенти со дијагноза на акутен холециститис. Материјали и методи: Спроведена е аналитичка (случај-контрола) студија во која учествуваа 139 пациенти со дијагноза на акутен холециститис и примени на Универзитетската клиника за дигестивна хирургија. Меѓу нив, 71 пациент беа распоредени во испитуваната група, додека 68 пациенти беа во контролната група. Пациентите во испитуваната група добија ран третман со LC во рок од 0-7 дена од почетокот на симптомите, додека пациентите во контролната група беа подложени на одложен третман со LC помеѓу 6-12 недели од почетокот на симптомите. Изборот на пациенти беше направен со користење на едноставен метод на случаен избор, следејќи ги однапред одредени критериуми за вклучување и исклучување. Резултати: Кај пациентите од двете групи, немаше статистички значајна разлика во возраст, пол, образование, место на живеење, минати болести, коморбидитет и претходна абдоминална операција за p>0,05. Сепак, постоеше сигнификантна разлика помеѓу групите во однос на вкупните трошоци, со значително повисоки трошоци забележани при одложен третман на пациенти со акутен холециститис (т-тест за независни примероци=-37,644 df=137 p=0,0001). Заклучок: Беа забележани значајни варијации во вкупната должина на болничкиот престој и болничките трошоци помеѓу двете групи, што укажува дека лапароскопскиот третман за акутен холециститис е поврзан со повисоки трошоци и подолг престој во болница.

Introduction

Diseases affecting the biliary tree are prevalent in the gastrointestinal tract (GIT) and are known for their significant morbidity and mortality rates[1]. Acute infection of the biliary tree typically manifests as acute cholangitis or acute cholecystitis. Acute cholangitis is a systemic infectious disease that can potentially be life-threatening, thus requiring urgent treatment. In contrast, acute cholecystitis refers to the inflammation of the gallbladder[2]. The nature of acute cholecystitis is frequently obstructive, primarily resulting from impacted stone in the cystic duct. The incidence of cholecystitis increases with age. There is a notable rise observed among the elderly population as opposed to younger individuals. When considering gender distribution, cholecystitis is found to be 2 to 3 times more frequent in females than in males. Acalculous cholecystitis is more frequent in older men[3,4]. Among patients with abdominal pain, 3-10% are found to have acute cholecystitis[5,6]. Treatment of calculous gallbladder by laparoscopic cholecystectomy has been in use since 1987. The literature has reported a growing number of studies focusing on the laparoscopic removal of the gallbladder in cases of acute cholecystitis in recent years[7]. Early laparoscopic cholecystectomy is defined as a procedure in which the gallbladder is removed laparoscopically within the first 7 days from the onset of symptoms, while delayed laparoscopic cholecystectomy is laparoscopic removal of the gallbladder within 6-12 weeks from the onset of symptoms after conservative treatment for acute cholecystitis. According to the Cochrane Database[8], there are no significant disparities in complication and conversion rates between laparoscopic cholecystectomy procedures conducted during the acute phase and those performed 6-12 weeks after symptoms have subsided. The intervention should ideally be put into effect as soon as possible, and the golden period is typically within the first 72 hours following the onset of symptoms[9]. Numerous meta-analyses of randomized clinical trials have consistently shown that early laparoscopic cholecystectomy is a safe procedure for acute cholecystitis. This approach not only reduces hospital stay and total costs, but also improves the patients' quality of life. In comparison to delayed laparoscopic cholecystectomy, early intervention is considered the most effective treatment option[8-13].

The aim of the study was to examine the overall expenses incurred by hospitals and the duration of hospitalization concerning delayed laparoscopic cholecystectomy in patients diagnosed with acute cholecystitis.

Materials and methods

This analytical (case-control) study included 139 subjects diagnosed with acute cholecystitis (study group and control group), treated with laparoscopic cholecystectomy. The sample of participants in each group was chosen by the method of simple random sampling, ensuring that the set inclusion and exclusion criteria were met. To achieve the study objectives, information gathered directly from patients, data extracted from existing medical records, and observations made by the researcher were utilized.

The study group consisted of 71 patients diagnosed with acute cholecystitis and hospitalized at the University Clinic for Digestive Surgery in Skopje. Within a span of 0 to 7 days following the onset of symptoms, these patients received a prompt treatment in the form of early laparoscopic cholecystectomy. To analyze the proposed hypotheses, this patient group was categorized into two subgroups. The first subgroup consisted of individuals diagnosed with acute cholecystitis who underwent laparoscopic treatment within 0-3 days after the initial onset of symptoms. The second subgroup included patients with acute cholecystitis who underwent laparoscopic treatment within 4-7 days from the onset of symptoms.

The control group consisted of 68 individuals who had been diagnosed with acute cholecystitis and were subjected to delayed laparoscopic cholecystectomy. These patients were initially admitted and treated conservatively at the University Clinic for Digestive Surgery and other healthcare facilities. Subsequently, within the timeframe of six to twelve weeks from the onset of symptoms, they were readmitted to the same clinic for laparoscopic intervention.

In our study focusing on the analysis of total hospital expenses in patients treated for acute cholecystitis with early or delayed laparoscopic cholecystectomy, the following health services grouped by DRG with DRG code were used:

- H07B Open cholecystectomy with reference price 31,797 MKD – rounded to 32 000 MKD
- H08B Laparoscopic cholecystectomy with reference price 39,118 MKD – rounded to 39 000 MKD
- H64B Hospital conservative treatment of acute cholecystitis with reference price 13 841 MKD – rounded to 14 000 MKD.

Results

The average length of patients' postoperative hospital stay was 2.1±1.5 days. The minimum recorded duration of stay was one day, while the maximum lasted eight days (Table 1). The postoperative stay of the study group patients lasted an average of 2.32±2.3 days, while of the control group patients 1.9±1.5 days. Notably, more than 50% of patients in both groups had an average postoperative stay of 2 days.

Table 1 Descriptive analysis of the study group and control group according to postoperative hospital stay

Group	Number	Average days (Means)	Standard Deviation (Std.Dev.)	Standard Error (Std.Err.)	Minimum (Min)	Maximum (Max)
Study group	71	2,32	1,37	0,16	1	8
Control group	68	1,88	1,57	0,19	1	8
Total	139	2,10	1,48	0,12	1	8

t-test for independent samples=1.769 df=137 p=0.0792

There was no statistically significant difference in the average postoperative stay between the two groups of patients, as indicated by the t-test for independent samples (t=1.769, df=137, p=0.0792). The tabular and graphic display of the descriptive analysis of patients from both groups in terms of their postoperative hospital stay duration is presented in Table 1 and Figure 1.

Figure 1.
Descriptive analysis of the study group and control group according to postoperative hospital stay

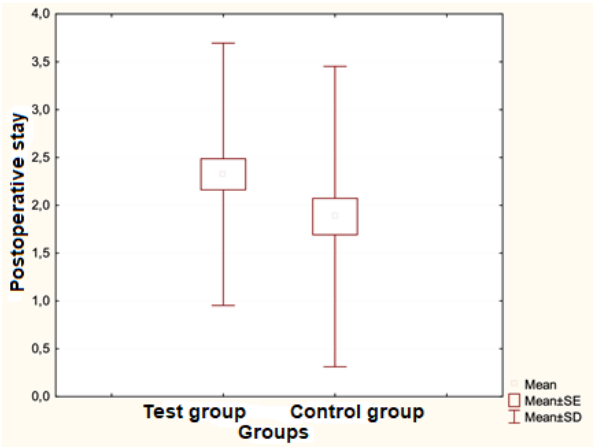


Table 2 Analysis of the control group according to duration of hospital stay during conservative treatment

Total hospital length of stay during conservative treatment

To understand the total hospital length of stay during the conservative treatment in the group treated with delayed laparoscopic cholecystectomy (control group), patients were divided into four categories: a) from 0 to 3 days; b) from 4 to 6 days; c) from 7 to 9 days and d) over 10 days. According to Table 2, the majority of patients, 39 (57.3%) had a total postoperative hospital stay of 4 to 6 days, followed by 15 (22.1%) with a stay of 7 to 9 days. Among patients in this specific group, 8 patients (11.8%) had a duration of hospitalization exceeding 10 days. Notably, this included 3 men (13%) and 5 women (11.1%). Only a small percentage of patients, specifically 2 (8.7%) males and 4 (8.9%) females, had a conservative treatment duration of zero to three days. There was no significant variation observed between the sexes concerning the overall length of hospital stay for conservative treatment, whether it was ≤ 3 days or ≥ 4 days. Similarly, no significant difference was found in terms of hospital stay durations of ≤6 days or less, or ≥ 7 days.

Total hospital length of stay during conservative treatment (days)		Gender		Total
		Male	Female	
0 - 3	Number	2	4	6
	%	2.94	5.88	8.82
4 - 6	Number	12	27	39
	%	17.65	39.71	57.35
7 - 9	Number	6	9	15
	%	8.82	13.24	22.06
≥10 days	Number	3	5	8
		4.41	7.35	11.76
Total	Number	23	45	68
	%	33.82	66.18	100

Pearson Chi-square=0.467, df=3, p=0.926

Fisher exact, two tailed test p=1,000 ≤ 3 days/ ≥ 4 days

Pearson Chi-square=0.44, df=1, p=0.508426 ≤ 6 days/ ≥ 7 days

The analysis indicated that for p>0.05 there was no significant difference in the total hospital length of stay of patients with acute cholecystitis treated with delayed laparoscopic cholecystectomy concerning the presence/absence of a comorbid condition, i.e., the hospital stay of these patients could not be attributed to any other health problem (Table 3).

There was no statistically significant variation in the overall duration of hospitalization of patients who underwent delayed laparoscopic cholecystectomy (p>0.05), regardless of whether they resided in a village or a city. This implies that the place of residence does not have a significant impact on the frequency of hospitalization (Table 4).

Total Hospital Costs

An analysis was conducted in terms of total costs based on individual prices (for both groups separately) under the DRG system of the Health Insurance Fund of the Republic of North Macedonia (HIFRNM) expressed in Macedonian denars (MKD).

Table 3

Analysis of the control group according to total hospital length of stay during conservative treatment and comorbid condition

Total hospital length of stay during conservative treatment (Days)		Comorbid condition		Total
		Yes	No	
0 - 3	Number	0	6	6
	%	0	8.82	8.82
4 - 6	Number	18	21	39
	%	26.47	30.88	57.35
7 - 9	Number	5	10	15
	%	7.35	14.71	22.06
≥10 days	Number	4	4	8
	%	5.88	5.88	11.76
Total	Number	27	41	68
	%	39.71	60.29	100

Pearson Chi-square=5.237, df=3, p=0,155

Table 4

Analysis of the control group according to total hospital length of stay during conservative treatment and place of residence

Total hospital length of stay during conservative treatment (Days)		Place of residence		Total
		Village	City	
0 - 3	Number	0	6	6
	%	0	8.82	8.82
4 - 6	Number	18	21	39
	%	26.47	30.88	57.35
7 - 9	Number	5	10	15
	%	7.35	14.71	22.06
≥10 days	Number	4	4	8
	%	5.88	5.88	11.76
Total	Number	27	41	68
	%	39.71	60.29	100

Pearson Chi-square=2..730 df=3, p=0.435

Table 5 Descriptive analysis of the study group and control group according to total costs

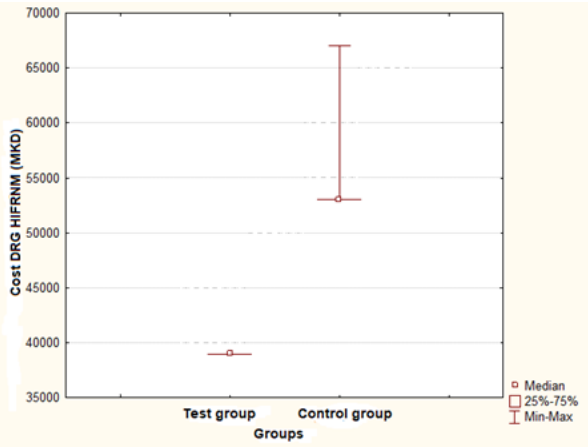
Group	Number	Average (Means)	Standard Deviation (Std.Dev.)	Median (Median)	Maximum (Max)
Study group	71	39000,00	0,000	39000,00	39000,00
Control group	68	53823,53	3 318,610	53000,00	67000,00

t-test for independent samples=-37.644 df=137 p=0.0001

The average cost per patient suffering from acute cholecystitis who received early laparoscopic cholecystectomy in the study group was 39000 MKD (Table 5). In the control group, the average cost for a patient who underwent delayed laparoscopic cholecystectomy for acute cholecystitis was 53823 MKD. The cost ranged from a minimum of 53 000 MKD to a maximum of 67 000 MKD (Table 5). In terms of total costs, there was a statistically significant difference (t-test for independent samples=-37.644 df=137 p=0.0001) between the study group and control group with significantly higher costs during delayed treatment of patients diagnosed with acute cholecystitis.

Total costs, showing the single prices within the DRG system of the HIFRNM in Macedonian denars, are illustrated in Figure 2.

Figure 2.
Descriptive analysis of the study group and control group according to total costs



Discussion

In the present day, cholecystectomy is presented as a surgical method for management of acute cholecystitis. Numerous studies have been conducted regarding the utilization of cholecystectomy during the era of open surgery, as well as in the present age of laparoscopic surgery. These studies have shown that undergoing early surgery within 7 days of the onset of symptoms (preferably within 72 to 96 hours) leads to a shorter hospital stay, faster recovery, and lower overall hospital expenses. Moreover, this approach does not show any significant variance in terms of mortality and morbidity, offers an improved quality of life and is considered the optimal treatment option for acute cholecystitis[7, 9].

The economic evaluation involves the comparison of the costs and benefits of multiple medical treatments and strategies to improve the most appropriate decision-making process in solving a particular medical problem. The findings in multiple randomized studies involving patients who have undergone treatment for acute cholecystitis indicate that the realization of an early laparoscopic cholecystectomy leads to decreased overall hospital expenses and improved quality of life when compared to a delayed laparoscopic cholecystectomy[14, 15].

Compared to delayed laparoscopic cholecystectomy in cases of acute cholecystitis, early laparoscopic cholecystectomy has been found to result in decreased overall hospital expenses as it requires only one hospital admission and a shorter postoperative recovery period. Starting from the 1980s (when laparoscopic cholecystectomy was not a common procedure), early cholecystectomy was characterized as an effective procedure in terms of economic benefit for patients with acute cholecystitis[16,17]. Over the past decade, there has been a growing emphasis on the economic benefits of early cholecystectomy, particularly the laparoscopic approach. Performing early laparoscopic cholecystectomy leads to a notable decrease in intraoperative blood loss, as well as a reduction in both hospital stay duration and overall hospital expenses[18]. A large meta-analysis of early laparoscopic cholecystectomy for acute cholecystitis demonstrated that overall hospital costs were lower compared to delayed laparoscopic cholecystectomy[13].

According to the results obtained in our study, the average patients' postoperative hospital length of stay was 2.1±1.5 days, with the shortest stay being one day and the longest eight days. In the study group, the average length of postoperative stay was 2.32±2.3 days, whereas in the control group, it was slightly shorter 1.9±1.5 days. Over 50% of patients in both groups experienced an average postoperative stay of 2 days. Similar results were presented in the study by Ashraf F *et al.*, where the postoperative stay in early laparoscopic cholecystectomy was 2.1 days, while delayed laparoscopic cholecystectomy led to a stay of 2.3 days[19]. In another study, different results were shown, where the postoperative stay in the early intervention was 6.5±2.3 days, i.e.12±5.5 days in the delayed intervention[20]. In the Biswas' study, the postoperative stay for the first group averaged 2 days, while for the second group 3.5 days[13]. Another study revealed that patients in the early group had a hospital stay lasting anywhere from 3.5 to 6 days, with an average of 4.8 ± 0.91 days. On the other hand, individuals in the delayed group had a total hospital length of stay ranging from 7 to 12 days, with a mean of 9.2 ± 1.61 days[22].

The majority of patients in our study, 39 (57.3%), had a total postoperative hospital length of stay of 4 to 6 days, during conservative treatment in the group treated with delayed laparoscopic cholecystectomy. In comparison to delayed laparoscopic cholecystectomy, patients who underwent early treatment experienced a shorter overall hospital stay by 4 days[13].

Both groups of patients were examined in terms of total costs calculated according to the single prices under the DRG system of the Health Insurance Fund of Macedonia (HIFRNM) in Macedonian denars (MKD). The Macedonian DRG model is built upon the Australian classification referred to as Australian Refined Diagnosis Related Groups (AR-DRG version 5.2). The foundation of AR-DRG lies in IKB-10-AM, specifically the tenth revision of the International Classification of Diseases and Related Health Problems. The Australian Classification of Health Interventions (ACHI) and Australian

Coding Standards (ACS) are available for reference on the NHS website. By the introduction and implementation of the DRG model in Macedonia, a key objective has been met: the standardization of health service costs across all healthcare facilities in the Republic of Macedonia for identical diagnostic groups and complexity levels. HIFRNM has set reference prices for each DRG service.

The fundamental concept behind DRG payment involves reimbursing per episode, which refers to the entire duration of treatment from hospital admission to discharge. This episode can span over one or multiple days, encompassing all healthcare services provided, and is covered within a single payment.([23])

The mean expense per patient in the study group receiving early laparoscopic cholecystectomy for acute cholecystitis reached 39 000 MKD. In the control group, the average cost per patient with acute cholecystitis treated with delayed laparoscopic cholecystectomy was 53 823 MKD, with a minimum cost of 53 000 MKD and a maximum cost of 67 000 MKD. There was a statistically significant difference between the study group and control group in terms of total hospital expenses with a notable inclination towards higher costs in patients with acute cholecystitis who received delayed treatment. In a multicenter randomized study, patients who underwent early laparoscopic cholecystectomy incurred an average total hospital cost of 2,919 euros, while those who underwent delayed elective laparoscopic cholecystectomy following conservative treatment had costs averaging 4 262 euros[24]. Another study revealed that patients who underwent early laparoscopic cholecystectomy had total hospital costs of £5 911, whereas those in the delayed group had expenses amounting to £6,132 14. The national health system of Great Britain saves an average of 8 million pounds (8.9 million euros) annually by utilizing early laparoscopic cholecystectomy for acute cholecystitis[25]. Another study found that each early laparoscopic cholecystectomy operation could have the potential to save £645. Assuming that 74% of cholecystectomies are delayed laparoscopic cholecystectomies and using a figure of 57,000 cholecystectomies per year, this study suggests that implementing early rather than delayed laparoscopic cholecystectomy could save the national health system £27,000,000 per year. Moreover, the calculations show that the current net value of early laparoscopic cholecystectomy is £3 920 and that of delayed laparoscopic cholecystectomy is £4 565, indicating that early laparoscopic cholecystectomy is also the more cost-effective treatment[26]. According to Gallagher's study, the average healthcare cost for early and delayed laparoscopic cholecystectomy was €4400 and €6004, respectively. A total of five studies provided sufficient data for a combined analysis[27].

Our data analysis and comparison with previously published papers reveal consistent findings regarding the effectiveness of early versus delayed laparoscopic cholecystectomy in acute cholecystitis on overall hospital expenses.

Conclusions

The total hospital length of stay of patients with acute cholecystitis treated with delayed laparoscopic cholecystectomy was significantly longer compared to that of patients treated with early laparoscopic intervention. The analysis demonstrated a statistically significant difference in terms of overall hospital costs between the two groups, indicating a tendency towards greater expenses for delayed laparoscopic treatment in acute cholecystitis.

References

1. Jensen KH, Jorgensen T. Incidence of gallstones in a Danish population. Gastroenterology 1991; 100:790. DOI: 10.1016/0016-5085(91)80027-7
2. Kimura Y, Takada T, Strasberg S. et al. TG13 current terminology, etiology, and epidemiology of acute cholangitis and cholecystitis. J Hepatobiliary Pancreat Sci 2013 Jan;20(1):8-23. DOI: 10.1007/s00534-012-0564-0
3. Huffman JL, Schenker S. Acute acalculous cholecystitis - a review. Clin Gastroenterol Hepatol 2009. DOI: /10.1016/j.cgh.2009.08.034
4. Yates MR 3rd, Baron TH. Biliary tract disease in pregnancy. Clin Liver Dis 1999; 3:131-147 DOI: 10.1016/s1089-3261(05)70058-1
5. Eskelinen M, Ikonen J, Lipponen P. Diagnostic approaches in acute cholecystitis; a prospective study of 1333 patients with acute abdominal pain. Theor Surg 1993;8:15–20 DOI: 10.3109/00365529409092499
6. Brewer BJ, Golden GT, Hitch DC, Rudolf LE, Wangensteen SL. Abdominal pain. An analysis of 1000 consecutive cases in a University Hospital emergency room. Am J Surg 1976;131:219–23. DOI: 10.1016/0002-9610(76)90101-x
7. Gurusamy KS, Samraj K. Early versus delayed laparoscopic cholecystectomy for acute cholecystitis (Review) 2009 The Cochrane Collaboration DOI: 10.1002/14651858.cd005440
8. Gurusamy KS, Samraj K. Early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Cochrane Database Syst Rev 2006;4:CD005440. DOI: 10.1002/14651858.cd005440.pub2
9. Yamashita Y, Takada T, Strasberg S. et al. TG13 surgical management of acute cholecystitis. J Hepatobiliary Pancreat Sci (2013) 20:89–96. DOI: 10.1007/s00534-012-0567-x
10. Сељмани Р. Рана лапароскопска холецистектомија кај акутен холецистит: Магистерски труд. 2011.
11. Papi C, Catarci M, Ambrosio D, Gili L, Koch M, Grassi GB, et al. Timing of cholecystectomy for acute calculous cholecystitis: a meta-analysis. American Journal of Gastroenterology 2004; 99 (1):147– 155. DOI: 10.1046/j.1572-0241.2003.04002.x
12. Lau H, Lo CY, Patuil NG, Yuen WK. Early versus delayed interval laparoscopic cholecystectomy for acute cholecystitis. Surg Endosc 2006; 20:82–7. DOI: 10.1007/s00464-005-0100-2

13. Gurusamy K, Samraj K, Glund C, Wilson E, Davidson R. Meta-analysis of randomized control trials on the safety and effectiveness of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Br J Surg. 2010;97:141–50. DOI: 10.1002/bjs.6870

14. D.A.L. Macafee, D.J Humes, G. Bouliotis, I.J. Beckingham. Prospective randomized trial using cost-utility analysis of early vs delayed laparoscopic cholecystectomy for acute gallbladder disease British Journal of Surgery 2009;96:1031-1040. DOI: 10.1002/bjs.6685

15. Wilson E, Gurusamy K, Gluud C, Davidson BR. Cost-utility value-of-information analysis of early vs. delayed laparoscopic cholecystectomy for acute cholecystitis. British Journal of Surgery 2010; 97:210-219. DOI: 10.1002/bjs.6872

16. Jarvinen HJ, Hastbacka J. Early cholecystectomy for acute cholecystitis: a prospective randomized study. Ann Surg 1980;191: 501–5. DOI: 10.1097/00000658-198004000-00018

17. Norrby S, Herlin P, Holmin T, Sjodahl R, Tagesson C. Early or delayed cholecystectomy in acute cholecystitis? A clinical trial. Br J Surg 1983; 70: 163–165 DOI: 10.1002/bjs.1800700309

18. Chandler CF, Lane JS, Ferguson P, Thompson JE, Ashley SW. Prospective evaluation of early versus delayed laparoscopic cholecystectomy for treatment of acute cholecystitis. Am Surg 2000; 66: 896–900. DOI: 10.1177/000313480006600921

19. Ashraf F. et al. Early versus delayed laparoscopic cholecystectomy for management of acute calculus cholecystitis: Our experience at King Hussein Medical Center. Journal of the Royal Medical Services 2012; 19:2 DOI: 10.5455/medarh.2020.74.34-37

20. Kawaguchi K. et al. Early laparoscopic cholecystectomy for acute cholecystitis in accordance with Tokyo guidelines for the management of acute cholangitis and cholecytitis. General Med 2013, 2:1 DOI: 10.4172/2327-5146.1000127

21. Biswas SK, Saha JC, Rahman MM, Rahman RA. Laparoscopic cholecystectomy in acute calculous cholecystitis-experience at district level hospital. Fardipur Med Col J 2010; 5(1):3-6. DOI: 10.3329/fmcj.v5i1.6804

22. Saber Ahmed Morgan M, Madbouly Abd El-Wahab A E, Salem A. Comparative study between early versus delayed laparoscopic cholecystectomy in cases of delayed presentation of acute cholecystitis. Al-Azhar Medical Journal 2022; 51(3): 1801-1810. doi: 10.21608/amj.2022.245218

23. Yucel E. et al. Predictive factors for conversion to open surgery during laparoscopic cholecystectomy. Cumhuriyet Medical J. 2013;35:510-517. DOI: 10.7197/1305-0028.2010

24. Buchler MJ et al. Acute cholecystitis: early versus delayed cholecystectomy, a multicenter randomized trial (ACDC study, NCT00447304). Ann Surg. 2013;258(3):385-93. DOI:

10.3410/f.718105549.793485718

25. Wilson E. et al. A cost utility and value of information analisys of early versus delayed laparoscopic sholecystectomy for acute cholecystitis. Br J Surg. 2010.;97:210-219. DOI: 10.1002/bjs.7170

26. Doa'a Kerwat, Zargaran A, Bharamgoudar R, Arif N, Bello G, Sharma B, Kerwat R. Early laparoscopic cholecystectomy is more cost-effective than delayed laparoscopic cholecystectomy in the treatment of acute cholecystitis. Clinico Economics and Outcomes Research 2018; 10: 119-125, DOI: 10.2147/CEOR.S149924

27. Gallagher TK, Kelly ME, Hoti E. Meta-analysis of the cost-effectiveness of early versus delayed cholecystectomy for acute cholecystitis. BJS Open 2019; 3 (2): 146–152, DOI: 10.1002/bjs5.50120