Original scientific paper

MOST FREQUENTLY DETERMINED CARRIAGES OF INFECTIOUS AGENTS DURING HEALTH - HYGIENE EXAMINATION OF PERSONS EMPLOYED IN FOOD PRODUCTION AND TRADE

Aleksandra Silovska Nikolova*, Metodija Trajchev, Zlatko Pejkovski

[1]Faculty of Agricultural Sciences and Food, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia
*corresponding author: silovska@fznh.ukim.edu.mk

ABSTRACT

Food safety is one of the key factors for consumer health. Therefore, a lot of attention has been paid in the last few decades to the identification of biological hazards in food. They represent a very serious danger to the health and safety of consumers. The health status of food handlers is a very significant factor for food safety. For those reasons, it is necessary that they regularly perform the prescribed health-hygiene examinations in order to prevent the secondary contamination of food, thereby preventing the development of food-borne diseases. During the research period 2011-2020, it was established that 11,347 people did not have a health-hygiene examination during the inspections carried out by the Food and Veterinary Agency in the Republic of North Macedonia.The largest number of persons who did not perform a health-hygiene examination was observed in 2012, i.e. 2276 persons, compared to 2016, when the lowest number of persons (596) who did not perform a health-hygiene examination was ascertained. For the analyzed period, the competent authority removed from work a total of 3170 food handlers due to carriages of infectious agents. In 2012, the largest number of removed persons was recorded (808), compared to 2018 when only 80 persons were removed due to carriage. Regular health-hygiene examinations for employees who are in contact with food allows timely detection of asymptomatic carriers of bacteria and parasites, which will reduce and prevent the development of food-borne diseases.

Key words: food operators, handling food, food handlers, safety, *Staphylococcus aureus*.

INTRODUCTION

Today, great emphasis is placed on food safety because of its great importance for the consumer health. For this purpose, food producers, as well as state authorities, strive to increase consumer confidence in the safety of the food placed on the market.

In order for consumers to be sure that the food they consume is safe, it is necessary that the dangers in food are minimized and that it does not cause harmful consequences to their health.

Lee et al., (2012) point out that foodborne diseases remain responsible for high levels of morbidity and mortality in the general population. Millions of people suffer from foodborne diseases, they are becoming a growing public health concern worldwide (Al Mamun et al., 2019). The high incidence of foodborne diseases has led to a global concern for food safety (van Tonder, 2007).

Humans are a source of a large number of infections; the causative agents are present in the nose and throat secretions, in feces, urine, blood, and on the skin.

The person suffering from a certain infectious disease expels the causative agents of the infection into the external environment even after they have recovered from it. Carriage is a

condition where a person excretes pathogenic agents and can be a source of infection, even though they are no longer sick.

If the pathogen expulsion lasts up to three months, then it is a case of acute carriage. It is typical for dysentery, cholera, and streptococcal and staphylococcal diseases. If, on the other hand, the carriage lasts longer than three months, then it is a matter of chronic carriage and it is typical for scarlet fever, paratyphoid fever, and other diseases. In contrast, healthy carriers carry the pathogenic microorganisms, but have not developed signs of the disease. The population often carries the bacteria *Staphylococcus aureus,* which is present in the mucous membrane of the throat and nose, and can lead to contamination of food via unwashed hands, coughing, and sneezing. For those reasons, timely detection of those employees through the mandatory health-hygiene examinations that need to be performed every six months is very important because *Staphylococcus aureus* is one of the major bacterial agents that cause foodborne diseases in humans. This microorganism can cause food poisoning through the production of enterotoxins (Morse et al., cited in Gutiérrez et al., 2012).

The health status of food handlers is of great importance for food safety because they can contaminate food and cause the development of foodborne diseases. Baş et al., (2006) point out that food safety is closely related to the health status of food handlers. Michaels et al., (2004) point out that over 300 reports have cited outbreaks caused by food-borne diseases. Sick or asymptomatic food handlers were indicated to be the cause of this . Todd et al., 2007 stated that out of a total of 816 outbreaks, as many as 232 outbreaks were caused by food handlers who had asymptomatic infections from pathogenic bacteria, while 154 outbreaks were caused by symptomatic food handlers. It is very difficult to prevent outbreaks caused by employees with asymptomatic infections by pathogenic bacteria.

Preventing secondary contamination from food handlers is an important step in the prevention of foodborne diseases. For this purpose, food handlers must fulfill the requirements of Article 83, Paragraph 2 of the Law on Food Safety ("Official Gazette of the Republic of Macedonia" No. 123/2015) which refers to the fulfillment of the conditions regarding the health status. Health status assessments are carried out in accordance with the Law on the Protection of the Population from Infectious Diseases ("Official Gazette of the Republic of Macedonia" No. 66/2004) and the Rulebook on the Method of Performance, Content of Examinations, Types of Examinations, and Deadlines for Performing Mandatory Health-hygiene Examinations of Employees ("Official Gazette of the Republic of Macedonia" no. 152/2007 and 8/2008).

MATERIAL AND METHOD

The research was conducted in February 2021. The data for this research was obtained from the Food and Veterinary Agency of the Republic of North Macedonia, after submitting an electronic request for free access to information of a public nature, archived with number 03-312/1 dated 5.2.2021, from the Food and Veterinary Agency.

The submitted data for the period 2011-2020 referred to:

- The number of food operators removed from work, due to not having performed a health - hygiene examination;
- The number of food operators removed from work after receiving a report about the carriage of infectious agents and
- The most commonly determined carriage of bacteria or parasites among employees.

RESULTS AND DISCUSSION

During the inspections among food operators, carried out by the Food and Veterinary Agency of the Republic of North Macedonia, certain shortcomings were determined. These shortcomings include the unperformed health - hygiene examinations of food handlers.

From Table 1, it can be concluded that for the period 2011 - 2020, a total of 11,347 food handlers did not perform a health - hygiene examination and were removed from work by the Food and Veterinary Agency, or the annual average for the analyzed period was 1,135 food handlers who did not perform a health - hygiene examination. The average deviation from the average number of persons who did not perform a health-hygiene examination is 531 persons. Variability is moderate for persons who were removed from work due to a non-performed health-hygiene examination for the analyzed period. In 2012, the largest number of persons was recorded, that is, 2276 persons who did not perform a health-hygiene examination, which is 20.06% (Figure 1) of the total percentage representation for the analyzed period. On the other hand, the smallest number of employees who did not perform a health-hygiene examination was ascertained in 2016, i.e. 596 persons or 5.25% (Figure1) of the total percentage representation for the analyzed period. From the average rate of change for the period 2011-2020, it can be determined that the number of people who were removed from work due to a non-performed health-hygiene examination decreased by -10.39% on average per year.

Table 1. An overview of food handlers who have not performed a health-hygiene examination, determined during the inspection carried out by the Food and Veterinary Agency for the period 2011-2020

Year		Number of persons
2011		1979
2012		2276
2013		735
2014		932
2015		761
2016		596
2017		1010
2018		1122
2019		1199
2020		737
Total		**11347**
Average 2011-2020		**1135**
Variation interval	**Min**	**596**
	Max	**2276**
SD		**531**
CV (%)		**46.83**
Average rate of change (%)		**-10.39**

Source: Food and Veterinary Agency of the Republic of North Macedonia

From the analyzed data, it can be concluded that a large number of food handlers have not performed a health-hygiene examination, which is contrary to the legal legislation. Pursuant to Article 83, Paragraph 2 of the Law on Food Safety ("Official Gazette of the Republic of Macedonia" No. 123/2015), food operators are obliged to ensure that only the persons who meet the health conditions can work in the food business. This can be confirmed only by carrying out health-hygiene examinations, in accordance with the regulations regarding the protection against infectious diseases. Pursuant to Article 44, Paragraph 2 of the Law on the Protection of the Population from Infectious Diseases ("Official Gazette of the Republic of

Macedonia" No. 66/2004), the health-hygiene examination is performed on persons who come into contact with food, i.e. persons who are involved in food production and trade in order to prevent infectious diseases. These persons are required to perform a health-hygiene examination every six months, pursuant to Article 5 of the Rulebook on the Method of Performance, Content of Examinations, Types of Examinations, and Deadlines for Performing Mandatory Health-hygiene Examinations of Employees ("Official Gazette of the Republic of Macedonia" No. 152/2007). Pursuant to Paragraph 3 of Article 83 of the Law on Food Safety ("Official Gazette of the Republic of Macedonia" No. 123/2015), food operators are obliged to carry out the health status confirmation of food handlers at their own expense.

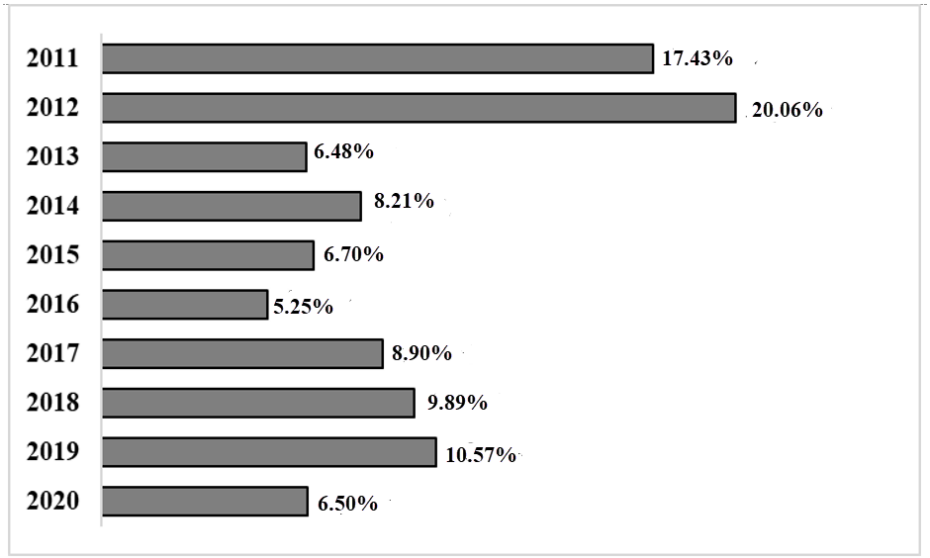

Figure 1. Graphic overview of the percentage representation of food handlers who have not performed a health-hygiene examination, confirmed during the inspection carried out by the Food and Veterinary Agency for the period 2011-2020

Food handlers (employees) are one of the main sources of microbiological contamination of food with pathogenic microorganisms. For this reason, a health-hygiene examination of employees is performed before their employment and then twice a year, in order to determine whether the employees are suffering from any infectious disease or may be carriers of infectious agents. The results of the performed health - hygiene examination are recorded in a sanitary book that should be kept by the legal entity, i.e. the natural person where the examined person is employed, pursuant to Article 10 of the Rulebook on the Method of Performance, Content of Examinations, Types of Examinations, and Deadlines for Performing Mandatory Health-hygiene Examinations of Employees ("Official Gazette of the Republic of Macedonia" No. 152/2007).

The health - hygiene examination of persons involved in the production or distribution of food, who come into direct contact with food at their workplaces, is in accordance with the Law on the Protection of the Population from Infectious Diseases ("Official Gazette of the Republic of Macedonia" No. 66/2004) and the Rulebook on the Method of Performance, Content of Examinations, Types of Examinations, and Deadlines for Performing Mandatory Health-hygiene Examinations of Employees ("Official Gazette of the Republic of Macedonia" No. 152/2007 and No. 8 /2008). Health - hygiene examinations include: medical examination of the presence of purulent skin diseases and infectious diseases that are transmitted through food and drinking water; *Staphylococcus aureus* screening with nasal and throat swabs;

Salmonella and *Shigella* screening by taking stool samples; O & P tests for *Enterobius (Oxyuris) vermicularis, Hymenolepis nana, Taenia Solium, Entamoeba histolytica* and *Lamblia intestinalis*. If pulmonary tuberculosis is suspected during the medical examination, a chest X-ray should be taken.

For persons employed in the production or sale of milk and dairy products, ice cream and other confectionery products and persons involved in food preparations in kitchens, the health-hygiene examination includes additional *Staphylococcus aureus* coagulase test. If clinical suspicion for an infectious disease that can be transmitted through food or drinking water exists, it will be necessary to perform other laboratory examinations with additional material, in order to confirm the diagnosis.

The Food and Veterinary Agency of the Republic of North Macedonia, after receiving a report from the competent institution conducting the health-hygiene examination, for a determined positive carrier for the causative agent of an infectious disease in a food handler, orders the removal of the person from the production and sale of food.

Table 2. An overview of the persons removed from the workplace after reports that they are carriers of infectious disease agents for the period 2011-2020

Year		Number of persons
2011		762
2012		808
2013		449
2014		306
2015		247
2016		135
2017		85
2018		80
2019		184
2020		114
Total		**3170**
Average 2011-2020		**317**
Variation interval	**Min**	**80**
	Max	**808**
SD		**258**
CV (%)		**81.39**
Average rate of change (%)		**-19.03**

Source: Food and Veterinary Agency of the Republic of North Macedonia

Table 2 lists data on persons who have been removed from their workplaces, after being notified that they are carriers of infectious disease agents for the period 2011-2020. It can be determined that for the period 2011-2020, a total of 3170 people were removed from their workplaces due to carriage. The largest number of carriers of infectious agents was observed in 2012, when 808 carriers of infectious agents were ascertained, which is 25.49% of the total percentage of the analyzed period (Figure 2). In 2018, the lowest number of carriers of infectious diseases was recorded, only 80 people, which represents 2.52% of the total percentage of the analyzed period. The average number of identified carriers of infectious agents in the period 2011-2020 is 317 people. The average deviation from the average number of persons with a determined carrier is 258 persons. Variability is high among people who have been found to be carriers during the analyzed period. The average rate of change in the number

of persons identified as carriers of infectious agents decreased by -19.03% per year on average for the period 2011-2020.

Pursuant to Article 46 of the Law on the Protection of the Population from Infectious Diseases ("Official Gazette of the Republic of Macedonia" No. 66/2004), it is stated that persons suffering from an infectious disease which is transmissible through food, water, objects, and direct and indirect contact, are prohibited from working in food production and food trade. The prohibition also applies to healthy carriers of infectious disease agents, if it is not possible to prevent the spread of the infectious disease with other measures. Health - hygiene examinations are mandatory for employees who represent a source of infection for as long as there are epidemiological indications.

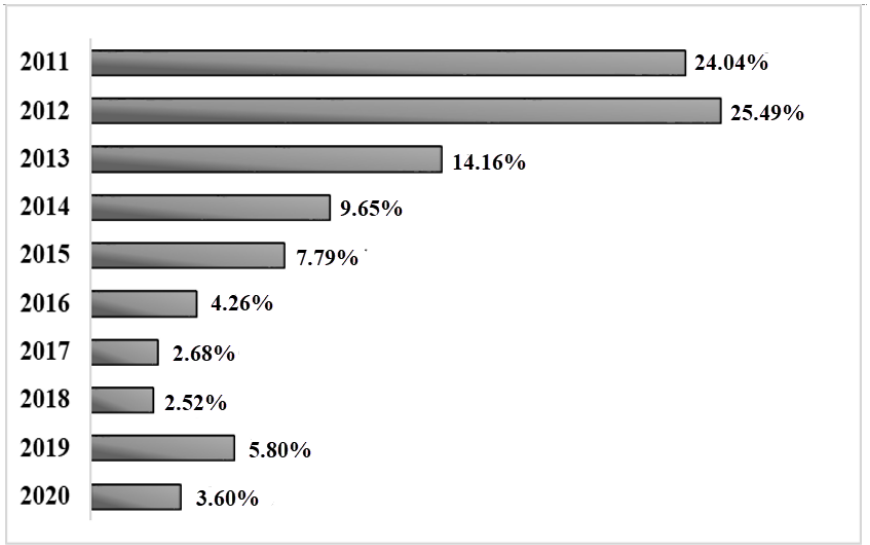

Figure 2. Graphic overview of percentage representation of the persons removed from the workplace after reports that they are carriers of infectious disease agents for the period 2011-2020

According to the data obtained by the Food and Veterinary Agency, 99% of the cases are carriers with a positive finding of *Staphylococcus aureus* isolated from the throat and nose. Humans are considered to be a significant epidemiological source of *Staphylococcus aureus* because 25 to 50% of the population of healthy people are carriers of this bacterium in the mucous membrane of the nose, the throat, the hair and the skin of very healthy people (Danev, 1999). *Staphylococcus aureus* is considered to be one of the most common causes of foodborne diseases, which represents a major public health problem worldwide (Balaban & Rasooly, 2000; Le Loir et al., 2003; Hennekinne et al., 2012). People are usually asymptomatic carriers of *Staphylococcus aureus* in the nose, throat and skin. Thus, food handlers can be an important source of food contamination. *Staphylococcus aureus* can remain viable on hands and environmental surfaces for extended durations after initial contact (Kusumaningrum et al., 2002). Poor hygiene in the production plant, environmental surfaces, and employees, is one of the reasons for contamination of raw materials, semi-finished, and finished products. It has the ability to form biofilms that allows it to survive in an unfavorable environment (Kaplan et al., cited Gutiérrez et al., 2012). In order to reduce the risk of staphylococcal poisoning, Marinculić et al., (2009) state that it is necessary to carry out regular health - hygiene examinations of food handlers, in order to determine asymptomatic staphylococcal carriers.

CONCLUSION

Based on the obtained results of this research, the following conclusions can be made: the regular implementation of health-hygiene examinations for persons who come into contact with food and are involved in the production and sale of food reduces and prevents the development of foodborne diseases; regular health - hygiene examinations help to detect asymptomatic healthy carriers of bacteria and parasites because asymptomatic healthy carriers are very difficult to detect otherwise; food operators, as natural or legal persons, need to ensure that the people who work in the food business meet the conditions regarding their health status , and that health-hygiene examinations for confirmation of the health status are carried out in accordance with the regulations applied for protection from contagious diseases and the number of people who have not performed a health-hygiene examination and yet come into contact with food can be decreased by frequent controls by the competent state authorities and by educating the operators about the importance of timely implementation of health - hygiene examinations among employees.

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