

ORIGINAL PAPER

MAIN CHARACTERISTICS OF ACUTE RESPIRATORY DISEASES IN ATHLETES

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ABSTRACT

Introduction. Acute respiratory diseases (ARD) are widespread infections among athletes which lead to serious defeats in sports.

The objective of the study was to investigate ARD in athletes, to identify the risk factors, and propose appropriate preventive measures.

Material and methods. The study involved 189 students from the National Sports Academy (NSA) "V. Levski" Sofia, Bulgaria, who were interviewed by the method of direct standardized interview and through the NSA distance learning platform.

Results. There was a statistically significant deterioration in the results achieved by elite athletes who had ARD, compared to other athletes. In 48.0% of cases, ARD had an impact on their performance in major competitions. In team sports and indoor sports, there was a higher risk of infection and spread of ARD.

Conclusions. Enhanced prevention and control measures and provision of immunizations with influenza vaccines are needed, especially for elite athletes and their teams.

Keywords: athletes, acute respiratory diseases, prevention.

RÉSUMÉ

Principales caractéristiques des infections respiratoires aiguës chez les athlètes

Introduction. Les infections respiratoires aiguës (IRA) sont des infections répandues chez les athlètes qui entraînent de graves défaites dans le sport.

L'objectif de l'étude était d'étudier les IRA chez les athlètes, d'identifier les facteurs de risque et de proposer des mesures préventives appropriées.

Matériaux et méthodes. L'étude a impliqué 189 étudiants de l'Académie Nationale des Sports (ANS), qui ont été interrogés par la méthode de l'entretien standardisé direct et via la plate-forme d'apprentissage à distance de la ANS.

Résultats. Il y a eu une détérioration statistiquement significative des résultats obtenus par les athlètes d'élite exposés aux IRA par rapport aux autres athlètes. Chez 48.0% d'entre eux, la maladie a eu un impact sur leurs performances dans les grandes compétitions. Dans les sports d'équipe et les sports en salle, le risque d'infection et de propagation des IRA était plus élevé.

Conclusions. Des mesures de prévention et de contrôle renforcées et la fourniture de vaccins antigrippaux sont

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Abbreviations list

ACTH – adrenocorticotrophic hormone

ARD – acute respiratory diseases

GPs – general practitioners

NSA – National Sports Academy

nécessaires, en particulier pour les athlètes d'élite et leurs équipes.

Mots-clés: athlètes, infections respiratoires aiguës, prévention.

INTRODUCTION

Acute respiratory diseases (ARD) are the leading cause of illness in athletes, often leading to absenteeism, disruption of training schedules, and skipping responsible competitions. These diseases have a viral aetiology (in 25-60% of cases the pathogens are rhinoviruses and coronaviruses)¹ and vary in severity – from mild to severe forms, life-threatening infections, such as influenza and its complications^{2,3}. ARD are the leading infections in gyms, as well as a major cause of visits to team doctors and consultations with general practitioners (GPs). In many cases, these diseases affect the athletes' participation and performance in competitions and increase the risk of catching other diseases and injuries, especially in the presence of fever^{4,5}. Cases of sudden and unexplained deterioration in athletes' performance have been reported in those with ARD or subclinical viral infections with a protracted course. Therefore, it is recommended to search an ARD as a cause in case of unexplained decline in sports performance. Viral infections that occur in other people without symptoms, can lead in athletes to a significant reduction of their performance^{6,7}. An important issue regarding the participation of people with ARD in competitions or training is the possibility of spreading the infection. If there is a risk of infecting teammates or other people involved in the sport activity, it is necessary to wait until the athlete fully recovers⁸. As athletes are expected to resume their training as soon as possible, knowledge of respiratory diseases, their characteristics, and features, as well as opportunities for prevention and control is extremely important.

THE OBJECTIVE OF THE STUDY was to investigate the ARD in athletes, to determine the risk factors and propose appropriate preventive measures.

MATERIALS AND METHODS

A total of 189 people participated in the study: 65 women (34.4%) and 124 men (65.6%), aged 19 to 49 years old, all of them second-year students at the National Sports Academy (NSA) "Vassil Levski", Sofia, Bulgaria.

For the purposes of the study, a questionnaire was developed, in electronic form, and filled in

directly on a web-based platform. This makes it possible to formulate different types of questions, make more complex answer scales, introduce tabular questions, and make different transitions, which largely ensures the maximum accuracy and reliability of the information and better quality of the collected data. In addition, the electronic form of the questionnaire greatly facilitated the process of entering the collected data and their further processing. The information collected with the help of the electronic questionnaire included general data on the respondents, number and duration of ARD, visits to GPs, potential factors increasing the risk of disease, participation in competitions, the results and performance achieved.

The study covered the autumn-winter seasons (October-April) for two consecutive years, and in the 2018/2019 season. 106 students were interviewed using the method of direct standardized interview. In 2019/2020, due to the state of emergency related to the COVID-19 pandemic, the questionnaire was adapted to be filled in an online environment and was completed by 83 students through the NSA distance learning platform.

The data were processed with the statistical package IBM SPSS Statistics 25, using the following statistical analyses: descriptive statistics, Chi-square test, Kolmogorov-Smirnov test of normality, Independent Samples Student t-test for equality of means, One-way ANOVA: Post Hoc Multiple Comparisons and Dunnett's Test. A p-value less than 0.05 was considered significant.

RESULTS AND DISCUSSION

Of all respondents, 124 (65.6%) reported having had an ARD and had been ill during the winter seasons of 2018/2019, and 2019/2020 (Figure 1).

In 2018/2019, the number of sick people was much higher than in 2019/2020, 79.2% and 48.2%, respectively. This significant difference is probably due to the announced flu holiday for pupils and students in February 2020, followed by the introduction of a state of emergency because of the COVID-19 pandemic, that severely limited contacts and opportunities for the spread of respiratory diseases.

There are no significant differences between patients with ARD by gender, with a slightly higher percentage of men falling ill during the study period

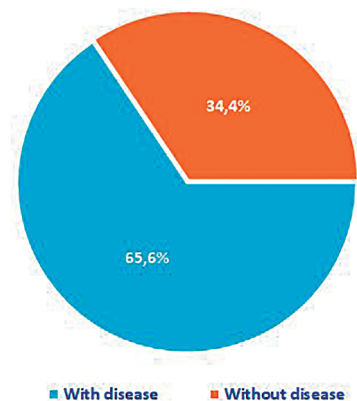
Table 1. Characteristics of the subjects, depending on the presence of ARD.

Variables	Respondents without a history of ARD (n=65)		Respondents with a history of ARD (n=124)		Overall (n=189)	
	%	n	%	n	%	n
Gender						
Female	38.5	25	61.5	40	100.0	65
Male	32.3	40	67.7	84	100.0	124
Age						
19-29 y.o.	29.1	43	70.9	105	100.0	148
30-49 y.o.	53.7	22	46.3	19	100.0	41
Type of sport						
Combat sports	34.2	13	65.8	25	100.0	38
Football	21.9	7	78.1	25	100.0	32
Basketball/Volleyball/Handball	31.8	7	68.2	15	100.0	22
Winter sports	50.0	7	50.0	7	100.0	14
Fitness	25.0	6	75.0	18	100.0	24
Other sports	42.4	15	57.6	34	100.0	59
Smoking						
Yes	19.4	7	80.6	29	100.0	36
No	37.9	58	62.1	95	100.0	153
Anabolic steroids and hormones						
Yes	0.0	0	100.0	7	100.0	7
No	35.7	65	64.3	117	100.0	182
Competitions						
National and international	42.0	29	58.0	40	100.0	69
Regional	30.0	36	70.0	84	100.0	120

(67.7%) compared to women (61.5%). The respondents' characteristics, depending on the history of ARD, are presented in Table 1.

There is a statistically significant decrease in ARD with the increasing age of respondents ($p=0.004$). More than two-thirds of the respondents less than 29 years old (70.9%) had ARD, while in the age group over 30 years old less than half of the participants was ill (46.3%). These data confirm one of the main characteristics of ARD: young people get sick more, but with milder form, while adults get sick less, but with more complications, hospitalizations and higher mortality^{9,10}. Children and young people are the main spreaders of ARD, so to reduce the incidence of ARD, the preventive measures need to cover younger age groups.

Depending on the type of sport practised, the highest percentage of patients were footballers (78.1%), followed by fitness enthusiasts (75.0%), as well as athletes practicing basketball, volleyball, and handball (68.2%). Team sports such as football (which also has the highest number of players in each team), basketball, volleyball, handball, and fitness,

**Figure 1.** The incidence of ARD in elite athletes.

which are practised indoors, often in crowded gyms, predetermine a higher risk of infection and a higher incidence of ARD (Table 1, Figure 2). As the competitors have been in close contact for a long time and indoors, there is a high risk of exposure to various other infectious agents. Therefore, it is important to observe the preventive measures: regular and effective handwashing with soap and water/wiping with

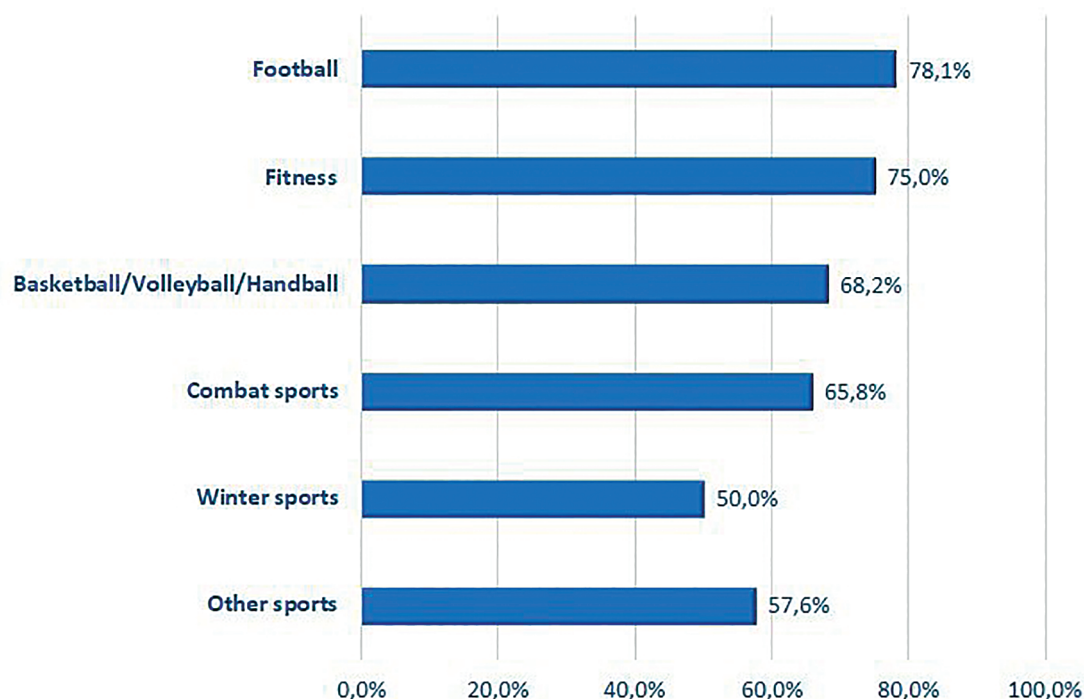


Figure 2. The incidence of ARD according to the type of sport practiced.

wet wipes or disinfectant, the use of individual water bottles, cups, cutlery and towels, cleaning and disinfection of sports equipment and surfaces, which can be contaminated with respiratory viruses, frequent ventilation of the premises¹¹.

19.1% of respondents are active smokers, and 3.7% (7 people) quit smoking more than a year before, and they are included in the group of non-smokers. It was found that smoking habits largely determine the incidence of ARD in respondents (Table 1). During the winter season, there was a statistically significant increase in ARD among smokers: 80.6% of them were ill, compared to non-smokers, 62.1% ($p=0.003$).

The severity of ARD is also higher among tobacco and tobacco products users (Table 2). The disease lasts on average one day more in smokers, they miss about one day more at school and training days during the winter. In addition, there is a statistically significant increase in the average number of visits to the doctors by smokers compared to non-smokers ($p=0.018$).

The use of tobacco and tobacco products has a direct effect on respiratory function, damaging the protective mechanisms of the respiratory system: it disrupts muco-ciliary clearance and reduces the effectiveness of the immune system against invading pathogens. Therefore, studies have shown a significantly higher risk of influenza infection and a greater likelihood of developing influenza-like illness among smokers, a greater risk of complications and more

severe forms^{12,13,14}. These effects are also likely to be related to the duration and severity of smoking (number of cigarettes smoked), which were not reported in the present study. In Bulgaria, the level of smoking among adults is the highest in the European Union, according to the European Commission (Bulgaria, Health profile of the country 2019) reaching 28%¹⁵. Even more worrying are the results for young people: about 37% of girls and 21% of boys smoke daily. NSA athletes smoke less than the general population, but the percentage of smokers remains high (19.1%), which does not correspond to the desire to maintain a healthy lifestyle, for better sports results and achievements.

A statistically significant association was found between ARD and the use of anabolic steroids and hormones by athletes ($p=0.049$). All persons who reported taking such substances were ill during the observation period (Table 1). The study used data on the use of anabolic-androgenic steroids (testosterone, nandrolone, danazol) and peptide hormones and growth factors (ACTH, somatotropin) from the list of the World Anti-Doping Agency, which has an immunosuppressive effect, thus proving their role for the development of ARD in athletes. A small part of the surveyed students reported taking anabolic agents or hormones (3.7%), probably due to the peculiarities of the direct standardized interview, with direct contact between the interviewer and the examined person.

Table 2. Severity of ARD depending on smoking status.

		n	Mean	Standard Deviation	Standard Error Mean
Duration of illness in days	Non-smokers	94	5.18	3.145	0.324
	Smokers	29	6.14	3.067	0.570
Missed school days because of ARD	Non-smokers	94	0.97	1.909	0.197
	Smokers	29	1.83	3.475	0.645
Missed working days because of ARD	Non-smokers	94	1.12	3.058	0.315
	Smokers	29	0.86	2.787	0.517
Missed training days because of ARD	Non-smokers	94	2.55	4.120	0.423
	Smokers	29	4.41	9.110	1.69
Visits to a doctor for symptoms of ARD	Non-smokers	94	0.61	0.751	0.077
	Smokers	29	1.03	1.085	0.201

Table 3. Significance of the disease for the performance and results achieved in competitions*

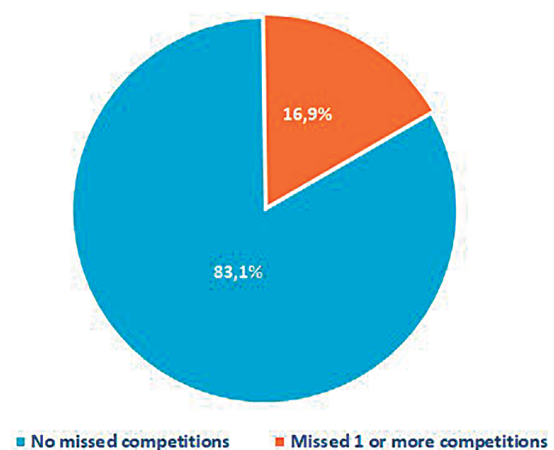
		Regional competitions	National and international competitions	Overall
Influence of the disease on the achieved results	Has effect on the results	n	5	12
		%	14.7%	48.0%
	Has no effect on the results	n	29	42
		%	85.3%	52.0%
	Total	n	34	59
		%	57.6%	42.4%

* χ^2 group difference significance test: p-value = 0.0053

The training of athletes participating in national as well as international competitions is much more serious, at a much higher level, so they can be defined as “elite” athletes. The study found that a smaller proportion of elite athletes was ill during the winter season (58%) than other athletes (70%), which is probably due to a greater attention to their health. However, this percentage is still significant for competitors of this rank (Table 1).

Of all respondents who had competitions during the observation period (124 people), 16.9% did not participate in the planned tournaments because of ARD (Figure 3). The total number of missed competitions during the season is 19.

In addition, nearly one-third of the competitors (28.8%) had a worse performance and did not achieve the expected results because of ARD (Table 3). It is worrying that the elite athletes missed an average of 0.6 tournaments, compared to 0.06 missed races by other competitors. There was also a statistically significant deterioration in the performance and results achieved by participants in national, as well as international competitions, compared to those who participated only in local and regional tournaments ($p=0.0053$). Intense physical training in elite athletes can have an adverse effect on the immune system and lead to increased susceptibility to infectious diseases.

**Figure 3.** The incidence of missed competitions because of ARD.

Suppression of immune function is most pronounced when the loads are high-intensity, continuous, and last more than 90 minutes¹⁶. The changes in immune system are associated with activation of the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis. This leads to elevated levels of stress hormones, such as adrenaline and cortisol, which suppress leukocyte function and cause immunosuppression¹⁷. Psychological stress associated

with training and competition at a high, elite level, can be an additional factor for the effects of intense physical activity on immune function, especially in periods around heavy, responsible competitions. There is a need to strengthen preventive measures against ARD and the introduction of immunization programs with influenza vaccines among athletes and especially among elite athletes. Influenza vaccination is the best way to prevent seasonal influenza. This is the first and most important step in protecting against the disease, especially for competitors during winter months¹⁸. Athletes are a high-risk population because of their lifestyle, frequent contact with many people, and travel to participate in tournaments, locally and internationally. Therefore, the prevention of influenza and ARD should include well-planned immunizations, good hygiene practices, and high health culture.

CONCLUSIONS

The results of the present study show the notable influence of ARD on sports, both in elite and non-professional levels. Respiratory infections are the cause of serious losses in sports. There is a statistically significant deterioration in the results achieved by sick elite athletes, and participation in responsible competitions is hindered. High-intensity physical activity, often accompanied by severe psychological stress, can be a reason for increased susceptibility to infectious diseases in the periods around competitions and preparation for them. Young people get sick more often than older people and since they are the main spreaders of ARD, it is important to ensure that preventive measures are in place, to reduce the risk of spread. Smoking and the use of anabolic steroids and hormones are also significant risk factors that need to be prevented and controlled. In team sports and indoor sports, there is a higher risk of infection and spread of ARD, so it is necessary to implement enhanced measures for prevention and control, and to provide immunizations with influenza vaccines to athletes, their teams, and staff.

Author Contributions:

Conceptualization, T.G., M.N. and K.R.; *methodology and software*, K.R.; *interviewing, data collection and processing*, T.G., M.N. and K.R.; *validation, formal analysis, draft preparation*, T.G.; *data curation and statistical analysis of the data*, K.P.; *review and editing*, T.G., M.N. K.R. and K.P.; *supervision*, M.N. All authors have read and agreed with the final version of this article.

Compliance with Ethics Requirements:

"The authors declare no conflict of interest regarding this article"

"The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law. Informed consent was obtained from all the patients included in the study"

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