

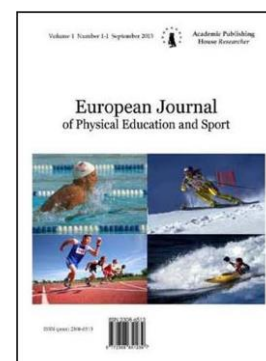
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Compliance with Hygiene Rules and Frequency of Infectious Diseases Incidents at Sports/Fitness Centers: Comparative Study/Analysis between Recreational Basketball Players and People who Working out at Health Clubs

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Abstract

The lack of personal hygiene (Luke, d'Hemecourt, 2007) and decontamination of sports centers (CDC, 2003; Duckro et al., 2005) contribute to the cause and transmission of diseases between the athletes (Collins – O'Connell, 2012) and people that work out in these facilities.

The aim of this study is to investigate the implementation of personal hygiene rules among the amateur basketball players and athletes working out in fitness centers. Moreover, the conditions of hygiene that exist in these specific facilities used by the participants of this study were analyzed. In the end, an analysis between recreational basketball players and the people who work out in health clubs is conducted, in order to examine whether the first are efficiently informed of the hygiene rules compared to the latter.

Survey and quantitative analysis, with data gathered through questionnaires which were distributed and completed by 923 participants. The sample was random and evenly selected among amateur basketball athletes in basketball teams and people working out at fitness centers. The data were analyzed with quantitative methods with statistical package SPSS 22.

The Analysis brought out that recreational athletes tend to not apply personal hygiene rule thoroughly. Low performance on personal hygiene is highly related to the frequency that recreational basketball athletes become ill or infected in their sports halls. People working out at health clubs appear more competent in the application of hygiene rules, their sports spaces tend to be more hygiene friendly and therefore they are less often ill or infected in comparison to recreational basketball athletes.

Keywords: skin diseases, infectious diseases, outbreaks, competitive sports, epidemiology.

1. Introduction

The environments in which athletes compete or practice and people work out, provide various opportunities for the transmission of infectious organisms (Collins – O'Connell, 2012; Cohen et al., 1992; Smith et al., 2006). The requirements for the transmission of infectious agents are: a source of the agent, an adequate susceptible host, and a mode of transmission for the agent to the host (Siegel et al., 2007; Minooee et al., 2015). Transmission of infectious agents to the host

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can occur through direct or indirect contact, droplets, airborne routes, or percutaneous or mucous membrane exposure (Siegel et al., 2007; Harris, 2011)

In athletes, the most common way to spread infections is through skin contact and respiratory tract, but blood borne, sexually transmitted, and even cardiac infections occur (Harris, 2011).

The athlete's skin is ideally suited for infection (Collins – O'Connell, 2012; Likness, 2011; Cordoro, Ganz, 2005; Lear et al., 2011). The athlete's activities facilitate the entry of microorganisms into the epidermis. The facilitation results in two different processes. Firstly, supersaturation of the stratum corneum (the first layer of protection of the skin) due to sweating and soaked clothes, which allows easy passage of the microorganism via the epidermis. Secondly, most athletes experience abrasions and cuts that allow the entrance of the microorganism through the epidermis (Adams, 2002; Turbeville et al., 2006).

Respiratory tract infections classified as an upper respiratory tract infection or a lower respiratory tract infection. Most upper respiratory infections are caused by virus but in some cases, bacteria may be the primary cause of infection. The micro-organisms enter the respiratory tract by inhalation of droplets and invade the mucosa, resulting in epithelial destruction with redness, edema and exudate. Lower respiratory infections may be viral or bacterial. Organisms enter the distal airway by inhalation, aspiration of gastric content or by hematogenous seeding. The pathogen multiplies in or on the epithelium, causing inflammation, increased mucus secretion, impaired mucociliary function which may lead to airway obstruction (Harris, 2011).

Sporting activities and their venues can put athletes at risk. Skin-to-skin contact, sneeze, cough or talk which is inherent in many sports, encourages the spread of microorganisms among the team (Collins – O'Connell, 2012; Harris, 2011; Cordoro, Ganz, 2005; Lear et al., 2011; Reinberg, 2007). Athletes in both contact and noncontact sports frequently share equipment (Cohen et al., 1992; Likness, 2011) and towels (Lear et al., 2011; Nguyen et al., 2005), allowing the spread of fomites among team members. Many studies have documented the presence of bacteria, viruses (Collins – O'Connell, 2012), fungi, atypical mycobacteria (Cordoro, Ganz, 2005), and parasites on surfaces and especially on playing surfaces (Duckro et al., 2005; Hota et al., 2004).

People who work out at fitness centers also share equipment (Cohen et al., 1992; Likness, 2011) locker rooms (CDC), showers (CDC, 2003) and whirlpools (NFHS, 2011), making transmission much easier. Germs can spread indirectly from surfaces and through the air in the workout facility (Collins – O'Connell, 2012; Harris, 2011). Research indicates that typical gym equipment regularly carries germs such as Staphylococcus, Streptococcus viridans, diphtheroids, E. coli and Candida (Goldhammer et al., 2006). The most common contagious fungal infection among people who work out is tinea pedis, or athlete's foot (Likness et al., 2011; Wohlrab et al., 2006). This fungus grows best in dark, moist and warm environments, making sweaty feet, tucked inside running shoes, the perfect targets.

Disease outbreaks in competitive sports and health clubs are not new. Many outbreaks represent a variety of infectious diseases. This study aims to investigate whether the personal hygiene rules are implemented by the amateur basketball athletes and people who work out in fitness clubs and if so, to what extent. Moreover, an effort is made to compare amateur basketball clubs to people who work out in fitness clubs regarding their compliance with the hygiene rules.

2. Material and Methods

In frames of research needs, a quantitative analysis was implemented, with data gathered through questionnaires which were distributed and completed by 923 participants. The sample was evenly selected among athletes in basketball teams and athletes in fitness gyms.

The data was analyzed with statistical quantitative methods using IBM SPSS software. For the examination of the research hypothesis the following methods were used: i) Descriptive statistics to examine the behavior and the frequency of symptoms of the athletes ii) Bi-variate correlation to examine correlations between athlete's behavior and symptoms, iii) Chi-square test for independent samples to compare the behavior and frequency of symptoms between the two groups of athletes that participated in the research.

Participant's answered in three different group of questions regarding their personal behavior and environment: i) how often they apply the basic rules of personal hygiene, ii) How often they apply the rules for preventing infectious diseases, iii) How they evaluate the condition of

their sports halls in terms of hygiene. The responders had to choose an answer on a scale 1 to 5 (Likert), where 1 indicated never or poor hygiene and 5 indicated always or very good hygiene.

In a second group of questions, the athletes had to answer about their: i) frequency of illness symptoms such as flu, gastroenteritis etc, ii) frequency of skin symptoms such as rash, fungal, dermatitis etc, iii) frequency of illness shortly after another co-athlete had been ill. The responders had to choose an answer on a scale 1 to 5 (Likert), where 1 indicated very frequent symptoms no symptoms and 5 indicated no symptoms.

The groups of variables which corresponded to the three basic characteristics (frequency of application of hygiene rules and evaluating the hygiene of the sports hall), were combined in order to produce three new variables clustering the responders on a 1 to 3 scale (low frequency, medium and high).

In the second step of analysis all three variables which correspond to the attitude of athletes are tested with bivariate correlation in order to detect significant relationships among them. The basis hypothesis is that each pair of variables is not related to each other. A significance coefficient lower than 0,05 rejects the hypothesis and therefore the relationship between the variables is assumed to be important. A high Pearson coefficient shows a strong relationship between the pair of variables examined.

In the final stage of the analysis, Chi-square test (χ^2) for nominal or ordinal variables (frequency of symptoms) was used in order to identify significant difference in the behavior between basketball and fitness athletes.

The basic hypothesis is that each variable is not effected by the sports activity of the athlete, basketball or fitness in gyms. This null hypothesis is rejected if significance is lower than 0,05.

3. Results

The sample consists of 923 responders, 69,9 % male and 30,1 % female (table 1), 51,1 % of the responders were basketball athletes and 49,9 % were athletes in gyms (table 2).

Table 1. Demographics of the responders regarding their sex

	Frequency	Percent (%)
Valid Male	645	69.9
Female	278	30.1
Total	923	100.0

Table 2. Athletic activity of the responders

	Frequency	Percent (%)
Valid basket	467	50.6
fitness	456	49.4
Total	923	100.0

According to the results of descriptive statistics (table 3), most of the responders do not follow the rules for their personal hygiene as often as they should. The same is observed regarding the application of rules for the prevention of infectious diseases. Additionally, when asked for the hygiene level of their sports halls, the responses are not always positive.

Table 3. Frequencies for behavior of responders regarding hygiene rules, prevention rules and hygiene of sports halls

		Sports category	
		basket	Fitness
Frequency of applying rules of personal hygiene	Low	24.8%	0.0%
	Medium	65.5%	53.1%
	High	9.6%	46.9%
Frequency of applying rules of infectious diseases prevention	Low	19.9%	0.0%
	Medium	79.9%	91.9%
	High	0.2%	8.1%
Levels of hygiene of sports hall	Low	18.6%	0.0%
	Medium	80.1%	19.7%
	High	1.3%	80.3%

Bivariate analysis shows significant correlations between all pairs of variables (table 4). More specifically it is shown that when personal hygiene is high, it is less probable for an athlete to get infected by skin or illness symptoms. Contrary, bad hygiene of the sports halls is linked to more frequent symptoms of common illness, skin infections and adhesive illnesses among athletes.

Table 4. Pearson correlation for hygiene standards of the athletes and the frequency they were ill or infected during the last year

		How often have you had dermal symptoms during your sports activity such as rash, allergy, fungal etc?	How often have you been ill shortly after a fellow athlete who you share the same sports hall?
Applying rules of personal hygiene	Pearson Correlation	.505**	.494**
	Sig. (2-tailed)	.000	.000
Applying rules of infectious diseases prevention	Pearson Correlation	.524**	.571**
	Sig. (2-tailed)	.000	.000
Hygiene of sports halls	Pearson Correlation	.798**	.812**
	Sig. (2-tailed)	.000	.000

The strongest correlations are detected on the effect of the sports hall's effect on illness and infections symptoms (sports hall hygiene – illness symptoms = 0.798 & sports hall hygiene – infectious diseases between athletes = 0.812).

Coefficients for each pair of variables are strong enough to be considered as important factors in the frequency that an athlete gets ill, or infected:

Personal hygiene /	illness symptoms =	0.525
Infectious diseases prevention /	skin symptoms =	0.452
Hygiene of sports halls /	Infectious diseases =	0.494
Personal hygiene /	illness symptoms =	0.524
Infectious diseases prevention /	skin symptoms =	0.551
Hygiene of sports halls /	Infectious diseases =	0.571
Personal hygiene /	illness symptoms =	0.798
Infectious diseases prevention /	skin symptoms =	0.597
Hygiene of sports halls /	Infectious diseases =	0.812

In the last step of the analysis the goal was to compare the behavior of two different groups of responders: recreational basketball athletes and people who working out at health clubs. Applying Chi-square test (table 5, 6, 7), the hypothesis of similar behavior between the two groups regarding the variables for personal hygiene rules, prevention for infections rules and environment's hygiene is rejected (Sig.2=0 > 0,05). Therefore, it is assumed that considerable differences exist between the attitudes of the two groups of athletes.

Table 5. Chi-Square test for sports group and frequency of applying rules of personal hygiene

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	233.651 ^a	2	.000
Likelihood Ratio	288.021	2	.000
Linear-by-Linear Association	232.742	1	.000
N of Valid Cases	923		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 57.31.

Table 6. Chi-Square test for sports group and frequency of applying rules of infectious diseases prevention

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	129.664 ^a	2	.000
Likelihood Ratio	174.898	2	.000
Linear-by-Linear Association	128.848	1	.000
N of Valid Cases	923		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.77.

Table 7. Chi-Square test for sports group and levels of hygiene of sports hall

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	609.170 ^a	2	.000
Likelihood Ratio	761.486	2	.000
Linear-by-Linear Association	546.271	1	.000
N of Valid Cases	923		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 42.98.

From crosstabulation analysis, it is shown that the differences are very strong between the answers of basketball players and fitness athletes. Basketball players tend to be less cautious with hygiene rules and prevention of infectious diseases (table 8, 9).

Table 8. Frequency of answers of the responders from the two groups

		Frequency of applying rules of personal hygiene		
		Low	Medium	High
Sports category	basketball	24.8%	65.5%	9.6%
	fitness		53.1%	46.9%

Table 9. Frequency of answers of the responders from the two groups

		Frequency of applying rules of infectious diseases prevention		
		Low	Medium	High
Sports category	basketball	19.9%	79.9%	0.2%
	fitness		91.9%	8.1%

Furthermore, the hygiene of sports halls is much higher for fitness athletes than basketball athletes (table 10).

Table 10. Frequency of answers of the responders from the two groups

		Levels of hygiene of sports hall		
		Low	Medium	High
Sports category	basketball	18.6%	80.1%	1.3%
	Fitness		19.7%	80.3%

Chi-square test is used in order to check the relationship between the frequency one gets ill, infected by dermal or other infectious diseases. The original hypothesis states that the sports category is not correlated with the frequency that an athlete gets ill or infected is rejected for all three tested variables (tables 11, 12 and 13).

Table 11. Chi-Square test for sports group and frequency of illness

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	673.326 ^a	4	.000
Likelihood Ratio	896.234	4	.000
Linear-by-Linear Association	618.615	1	.000
N of Valid Cases	923		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.34.

Table 12. Chi-Square test for sports group and frequency of dermal infections

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	321.495 ^a	3	.000
Likelihood Ratio	384.594	3	.000
Linear-by-Linear Association	313.903	1	.000
N of Valid Cases	901		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 2.98.

Table 13. Chi-Square test for sports group and frequency of adhesive illness

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	782.183 ^a	4	.000
Likelihood Ratio	1071.007	4	.000
Linear-by-Linear Association	701.695	1	.000
N of Valid Cases	923		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 32.61.

However, the hypothesis is rejected for both cases since (Sig.2=0>0,05). As a result, significant differences are observed between the groups regarding how prone they are to dermal infections and adhesive illness. More specifically basketball athletes who earlier in the analysis were found to be more careless about their hygiene, seem to be more often ill and infected.

By observation of the distribution of answers between the two groups it is observed that:

–The evaluation of the hygiene of the sports hall has significant difference between the two groups of athletes (Table 9)

–Fitness athletes tend to be more consistent and cautious with their personal hygiene and they follow the rules in order to prevent any illness or infection more often than basketball athletes (Tables 5 and 7)

–Basketball athletes tend to be ill or infected more often than the fitness athletes in gyms (Tables 14, 15, 16).

Table 14. Frequency of answers of the responders from the two groups

		How often have you been ill (flu, cold, gastroenteritis) during the last year?				
		>3times	3 times	2 times	Once	Never
Sports category	basket	5.8%	70.0%	23.8%	0.4%	
	fitness		1.1%	24.3%	57.9%	16.7%

Table 15. Frequency of answers of the responders from the two groups

		How often did you have any dermal symptom (fungal, rash, dermatitis)				
		>3times	3 times	2 times	Once	Never
Sports category	basket	1.1%	56.8%	41.6%	0.4%	1.1%
	fitness	0.2%	7.5%	62.1%	30.2%	0.2%

Table 16. Frequency of answers of the responders from the two groups

		How many times did you get ill shortly after a co-athlete of yours was also ill?				
		>3 times	3 times	2 times	Once	Never
Sports category	basket	14.1%	69.2%	16.3%	0.4%	
	fitness			12.9%	55.9%	31.1%

4. Discussion

Sports and exercise provide an excellent setting for the transmission of communicable diseases (Harris, 2011; Likness, 2011). Outbreaks of viral, fungal, and bacterial skin infections are common in athletes (Likness, 2011; Collins – O'Connell, 2012). The agents most often are

responsible for the reported outbreaks in competitive sports are herpes simplex virus, Staphylococcus aureus, enteroviruses, tinea, Streptococcus pyogenes, hepatitis A and B viruses, measles virus, Leptospira species and Neisseria meningitidis (Collins – O'Connell, 2012; Harris, 2011; Lear et al., 2011; Luke, d'Hemecourt, 2007). Infectious agents such as Norwalk virus, rickettsia, chlamydia, and pseudomonas are also implicated in outbreaks, even though rarely (Turbeville et al., 2006). Moreover, people who work out in sports centers develop infections that in most cases are common with those of athletes in team sports (Goldhammer et al., 2006).

The transmission of infectious diseases can occur with person to person contact, common source, or vector transmission (Harris, 2011; Likness, 2011; Luke and d'Hemecourt, 2007). The most common mode of transmission is direct person-to-person (primarily skin-to-skin) contact (Sean et al., 2006; Collins – O'Connell, 2012) and through respiratory tract (Harris, 2011). Transmission through common-source exposure is also implicated, although not very common quantitatively. Common sources of exposure include contaminated water or watercoolers, water bottles, and drinking cups, athletic equipment, locker rooms, fencing equipment, soap and towels, whirlpools, swimming pools. In some outbreaks, multiple modes of transmission are reported. Blood-borne and airborne transmission is rarely reported except for measles outbreaks (Sean et al., 2010; Zinder et al., 2010).

The prevention of infectious diseases among athletes is of great importance. Primary prevention of infectious disease is the ideal goal, and deals with avoiding the development of the disease before infection occurs. Secondary prevention for infection control involves prevention of spread to others. Athletes are often exposed to many different people, travel in various environments locally and internationally for tournaments, and engage in high-risk activities, often in close contact with others (Likness, 2011; Zinder et al., 2010).

Since good hygiene of people participating in sports (Cordoro, Ganz, 2005; Goldhammer et al., 2006; Sean et al., 2006; Zinder et al., 2010) is of great importance for the prevention of infectious diseases, the current study tried to examine the hygiene conditions that exist in sports halls, the attitude of recreational basketball players as well as people working out in fitness centers regarding personal hygiene issues and the protection measures in order for the possible dangers to be comprehensible.

The study, showed that a great percentage of participants do not follow the rules of personal hygiene as often as they should and that poor personal hygiene is strongly correlated to higher probability for an athlete to have skin infections or illness symptoms. Furthermore, poor hygiene of the sports halls is linked to higher frequency of symptoms of common illness, skin infections and adhesive illnesses among athletes. In a more detailed analysis a serious difference is observed among the two groups when they evaluate the hygiene conditions of their sports hall: amateur basketball athletes report that the hygiene of their sports hall is poor, when people who work out evaluate their fitness hall higher regarding hygiene standards. Therefore, the correlation between the hygiene of the environment and the frequency of dermal or illness symptoms seems to be strong.

Another matter which was examined in this study was the degree in which the responders were informed regarding personal hygiene rules as well as the level of application of these specific rules. The original assumption was that amateur athletes practice in a systematic way and participate in matches and therefore they acquire a better knowledge of the prevention rules compared to people working out at fitness centers. However, the original assumption was precluded.

The analysis for the comparison between the recreational basketball athletes and people who work out, brought out the fact that considerable differences exist both in the attitude of the two groups as well as in the frequency they become ill or infected. The fitness athletes tend to be more consistent and cautious with their personal hygiene and they follow more often the rules in order to prevent any illness or infection compared to basketball athletes. As a result, basketball athletes tend to be ill or infected more often than fitness athletes in gyms.

The results of this research are common with the results of other surveys that poor personal and sports hall hygiene is correlated to higher probability for an athlete to have skin infections or illness symptoms. The authors describe and suggested the sports organization should strongly encourage and educate team members about good overall and hand hygiene, the importance of covering of wounds, and the benefits in terms of infection transmission of limiting sharing of equipment. Good personal hygiene helps reduce colonization of bacteria. Equipment must be handled in a manner to prevent transmission of infectious agents including proper cleaning and

sterilization of reusable equipment. Bacteria and viruses can exist on equipment. Methicillin resistant *Staphylococcus aureus* (MRSA) has been found on taping gel and whirlpool facilities in training facilities. Other bacteria especially *Pseudomonas* spp. have also been linked to infection outbreaks from use of whirlpools (CDC, 28).

Periodical surveillance of the frequency of infections within a sports team will allow athletic staff to identify outbreaks quickly and take all necessary measures to contain further transmission and prevent future outbreaks. Appropriate outbreak investigations should identify potential sources of exposure empirically. This procedure will allow prevention methods to be based on real data rather than on expert opinion or suggestion. Furthermore, athletic personnel should be trained properly in the identification of outbreaks and in control measures for specific infectious diseases to prevent further spread of an outbreak (Smith et al., 2006; Jaiosky et al., 2006; So et al., 2004).

5. Conclusion

In conclusion, a direct connection is found between the frequency of illness and infection symptoms and the consistency of recreational basketball athletes regarding application of hygiene rules. When the athletes are more careful with their personal hygiene, the less prone they are to illness and infections. Especially in sports such as basketball, the space tends to be less healthy and the athletes more careless regarding their personal hygiene and therefore they have a higher frequency of illness and infections. In addition to that the hygiene conditions of the sports hall are highly related to the frequency that the athletes tend to be ill or infected. Recreational basketball athletes should be informed on a more regular and efficient way and method regarding the need to apply personal hygiene rules, so that the frequency of diseases and infections in athletic halls should be reduced.

Training staff, coaches and athletes should be informed on a more regular and typical way and method regarding the need to apply personal hygiene rules, so that the frequency of diseases and infections in athletic halls should be reduced.

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