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2009 H1N1 flu pandemic among professional basketball players: data from 18 countries

La pandemia influenzale da H1N1 nel 2009 tra i giocatori professionisti di pallacanestro: dati da 18 diversi paesi

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INTRODUCTION

The 2009 H1N1 influenza pandemic represented a public health challenge at a worldwide level. A literature review of infectious outbreaks in competitive sports has highlighted the fact that influenza virus, the commonest community outbreak pathogen, has received little attention in the recent sporting literature [1]. The H1N1 influenza was declared a pandemic in June 2009 while the end of the phase 6 alert was announced in August 2010 [2, 3]. Evidently the 2009-10 basketball season coincided with the global outbreak of the disease and gave the chance of studying this subpopulation for the first time.

Propagation of influenza may integrate an innumerable host of occasions and daily situations of exposure, such as the use of public transportations, buildings' lifts, closed classrooms or workrooms, etc. Although basketball *per se* may seem as a little drop in a vast ocean, basketball may well create many chances of close contact whereupon H1N1 influenza could spread; the environments in which these athletes compete, practice, receive therapy for injuries, and travel, both domestically and internationally, provide varied opportunities for the transmission of infectious organisms [4]. Recognizing that during the time spent on court, in the weight room or in the locker room for games and training programs (main areas and lengthy time frames, where basketball players interact) chances of influenza transmission may arise, special recommendations had been issued by the International Basketball Association (FIBA), including recommended vaccination, strict rules of hand washing, but not postponement of competitions [5].

Acknowledging the potential role of basketball in the H1N1 context does not preclude the methodological difficulties of studying basketball-related factors in the spread of influenza, as the latter interplay represents a *terra incognita* in the literature. Potentially meaningful risk factors, such as domestic and international travel, educational programs, vaccination, hygiene improvement programs (to players, remain staff and equipment), seem nearly impossible to gather and quantify for basketball teams on a worldwide basis. As a result, the point of focus for the present, original but exploratory, analysis remains obligatorily limited upon rudimentary, tangible and widely available risk factors, such as the number of players per team, the population of the city where the team is based, and the latitude-longitude of the city-basis. However, it remains clearly important that the nature of outbreaks of infection among athletes are documented and delineated so that preventive measures may be undertaken [1].

In this context, this study aims to quantify and assess the impact of the 2009 H1N1 pandemic among professional basketball players, also evaluating possible predictors for H1N1 emergence in a team during the former period. Available and meaningful microenvironmental

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and macroenvironmental parameters were examined as possible risk factors.

PATIENTS AND METHODS

Data collection

The target population consisted of the top 60 countries according to the 2009 FIBA Ranking for men [6]. The research team browsed the official websites of all local Basketball Federations and clubs to gather relevant data, *i.e.*, top league professional teams reporting H1N1 cases during 2009-10 basketball season (September 2009 to June 2010). Subsequently, in case of no available data, we communicated with all local official Basketball Federations to collect the data. The communication was performed via a standard e-mail in July, 2010; in case of no reply a reminding e-mail was sent two weeks later. Where feasible, the additional assistance of local journalists was sought.

Where data were only available in the press, cases were also verified by subsequent communication with the national basketball federations. Possible known risk factors for influenza spread (number of players per team, the population of the city where the team is based, latitude and longitude of the city-basis) were recorded for all teams whose countries responded. The "number of players per team" factor was generated from the official websites of each team and assessed as players that played at least one game in the season (and thus had significant level of interactions among them).

Statistics

Occurrence of H1N1 cases in a team was treated as a binary variable (0: no cases, 1: H1N1 cases reported); the association between H1N1 occurrence and possible risk factors were assessed through univariate and multivariate logistic regression. The absolute values of latitude and longitude were entered into the models, so as to quantify distance from the Equator and the Prime Meridian; two additional comparisons (Western vs. Eastern hemisphere, Southern vs. Northern hemisphere) were made. An alternative, *post hoc*, ordinal logistic regression analysis aiming to make the distinction between teams with smaller/larger H1N1 spread (0: no cases, 1: one case, 2: two or more H1N1 cases reported) was additionally and exploratorily performed. The level of statistical significance was set at 0.05 for all analyses; nevertheless, taking into account the fact that information on some confounders was missing and the expected low participation rates, it was decided for results of borderline significance ($0.10>p>0.05$) to also be reported. Statistical analysis was performed with STATA 11.1 (Stata Corporation, College Station, TX, USA).

RESULT

After the multi-step search strategy (Figure 1a) relevant data were available for 18 countries (218 teams, 3,024 players, Figure 1b). Fifty two H1N1 cases in 19 teams were reported (Table 1). At the univariate analysis, a larger number of players presented as a risk factor for the emergence of H1N1 cases to a borderline extent (Odds Ratio, OR=1.19, 95% CI: 1.00-1.41, p=0.056; the increment of the logistic regression model pertained to increase by one player). In addition, a borderline association between the population of the city-basis of the team and the occurrence of H1N1 cases became evident (OR=1.01, 95% CI: 1.00-1.02, p=0.094, increment: increase by 100,000 citizens).

On the other hand, no significant association was demonstrated regarding latitude (OR=1.03, 95%CI: 0.98-1.08, p=0.322, 1 degree increment) and longitude (OR=1.00, 95%CI: 0.99-1.01, p=0.668, 1 degree increment) of the city-basis. The comparison of Western vs. Eastern hemisphere did not yield a statistically significant difference (OR=0.78, 95% CI: 0.28-2.14, p=0.629, reference category: Eastern hemisphere). Similarly, regarding the comparison of Southern vs. Northern hemisphere no significant difference was demonstrated (0/16 teams in the Southern hemisphere reported cases, while the respective rate was 19/202 in the Northern hemisphere, p=0.371, Fisher's exact test; logistic regression was not feasible due to the zero cell in the Southern hemisphere).

The multivariate logistic regression analysis confirmed the independent but borderline risk conferred by the number of players per team (OR=1.19, 95% CI: 0.99-1.43, p=0.060, 1 player increment), whereas the effect mediated by the population of the city-basis shifted slightly into the non-significant region (OR=1.01, 95% CI: 1.00-1.02, p=0.106, 100,000 citizens increment); this shift was rather expectable given the rather small sample size.

The exploratory, *post hoc* ordinal logistic regression analysis replicated the role played by the

number of players per team (p=0.074) and confirmed the trend for the city-basis population (p=0.122) at the univariate approach. Multivariate ordinal logistic regression was not deemed necessary, as only one risk factor (number of players per team) had proven borderline at the univariate ordinal model.

DISCUSSION

Taken as a whole, this report suggests that the microenvironment (as reflected upon the number of players per team) seemed to be a more meaningful predictor regarding H1N1 emergence in the context of a basketball team, com-

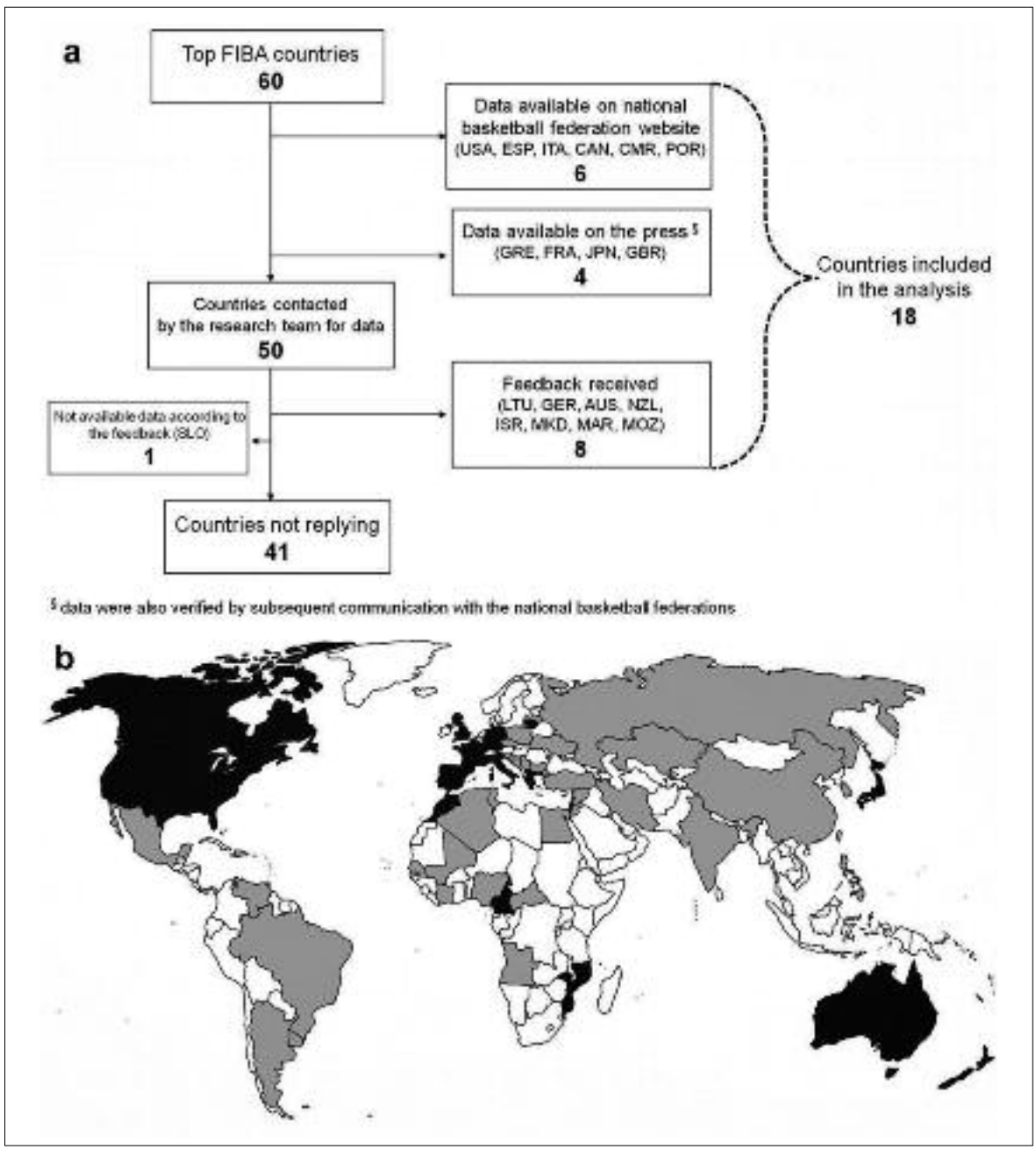

Figure 1 - (a) Flow chart describing the multi-step data collection process (the International Olympic Committee country codes were adopted in the abbreviations). (b) World map showing the 60 top FIBA countries (countries with available data are highlighted in dark gray, while countries without available data are depicted in light gray).

pared to the macroenvironment (city population). The number of players per team conceptually corresponds to the notion of crowding index, which may have facilitated the spread of H1N1. In this context, interestingly infectious outbreak of MRSA within a basketball team has also been reported, though MRSA outbreaks are more commonly recorded in the sporting literature [7, 8]. These findings may be inscribed into a wider context, as the importance of microenvironment in the epidemiology of influenza has been consistently emphasized, for instance in the case of cruise ships or English boarding schools reported [9, 10]. Although previous research has highlighted the role of latitude and longitude in the epidemiology of influenza, this study did not point to any modifying effects exerted by them [11].

Under a qualitative perspective, interestingly, infected players from the preeminent NBA league revealed intense experience with H1N1, stressing the peculiar reactions received after the news were announced despite their will, or their fear of imminent death after learning about H1N1 infection [12, 13]. These facts add up to the notion that occasionally public health pronouncements tend to generate panic when the global public is unprepared to perceive epidemiological rationale regarding the emerging outbreak [14]. In terms of additional measures, some examples included in Germany players receiving the H1N1 vaccine in order to avoid postponement of games [Dirk Kaiser, German Basketball League office, written communication, July 29, 2010], and in Australia, running separate camps within the nation [Lorraine

Table 1 - Number of teams, players who played at least one game and reported H1N1 cases by country during the 2009-10 Basketball Season.

No.	*Country*	*Number of cities hosting at least one team*	*Number of teams*	*Number of teams affected*	*Number of players who played at least one game*	*Reported H1N1 cases*
1	France	16	16	1	234	3
2	FYROM	4	9	0	139	0
3	Germany	18	18	3	271	8
4	Greece	6	14	6	244	13
5	Israel	11	12	0	147	0
6	Italy	16	16	2	259	5
7	Lithuania	10	13	0	211	0
8	Portugal	12	12	0	107	0
9	Spain	14	18	2	274	11
10	United Kingdom	13	13	1	145	4
11	USA*	27	29	3	420	5
12	Canada*		1	0	14	0
13	Australia§	8	7	0	98	0
14	New Zealand§		1	0	13	0
15	Japan	13	13	1	167	3
16	Cameroon	4	8	0	86	0
17	Morocco	8	10	0	124	0
18	Mozambique	4	8	0	71	0

*For USA and Canada, the NBA is the common men's professional basketball league. §For Australia and New Zealand, the continent's top common league, NBL, was taken into account.

Landon, Basketball Australia General Manager, written communication, July 31, 2010].

In terms of the true overall impact of the pandemic in this group, it should be noted that, as a rule and following the international recommendations, players diagnosed with H1N1 flu, by laboratory confirmation, refrained from any sporting activities during a minimum of 7 days after the appearance of the first symptoms [5]. This corresponds to between 1 and 3 missed days of competitive games (depending on the country) and depending on the individual case may have enormous impact on a team's performance and results.

Results, as in victory or loss, may have in turn significant consequences on the economics of a team which relies on consistent delivery of results to maintain sponsorship and home court attendance rates.

Nevertheless, meaningful limitations of our report should be declared.

Despite the solid international sample, data were available for 18 out of the 60 top countries (Table 1 - however, details from Italy are well included); consequently, a considerable loss of statistical power may have occurred, leading to a series of borderline findings which may have been significant in the 60-country pool. Interestingly, for Mexico, where the outbreak emerged, it has been an impossible task to find the relevant cases, as the country's basketball league has been in a severe crisis due to hassles between directors and the front office of the league [Carlos Chapa Gonzalez, Mexican Basketball journalist, written communication, August 12, 2010].

Of note, the comparability among the data stemming from very different countries may have been compromised, as the epidemic may have presented different characteristics in each country.

Moreover, the overall incidence rates per country could not be entered as possible predictors in the logistic models, as reliable data were not available for all countries.

Specifically, according to the European Centre for Disease Prevention and Control (ECDC), there is no collective table of incidence as data are not comparable across countries due to differences in healthcare system organisation, health care seeking behaviour, sentinel system organisation and functioning, and other factors [ECDC, written communication, October 20, 2010]. Also, the list of the studied potential risk factors and confounders was not inclusive; no information on the players' contact with non-athletes, domestic and international travel, availability of educational programs, previous vaccination history, immunity status and use of antivirals was available. In addition, further details of the reported cases, such as description of symptoms, were not available.

However, among the strengths of the study, should be acknowledged that the strict, exhaustive strategy method followed for the gathering of the information, assured the completeness and reproducibility of the background data. Given that announcements of the cases originated from the official medical teams in each case, they only refer to laboratory-confirmed cases.

Even though less than a third of the countries attempted to be recruited were eventually included, the final cohort of 18 countries from 5 continents certainly amount for a generalisable result. Finally, from an ethical point of view, names of players and teams affected (as well as announcement date of the case) can be released on request, which is not contrary to the principles of confidentiality, as the relevant data were announced at the press, as a rule.

CONCLUSION

In conclusion, the current study shows that even in environments where the best possible preventive and other medical care is provided (*e.g.*, competitive sports at the highest level) influenza continues to be a threat. Thus, by complementing the sporting literature on the neglected influenza outbreaks, we aim at providing insight for those who design complete preventive measures.

Elaborating on the obvious logic that the higher the number within a studied group the higher the likelihood that something will occur to one of the number within that group, our results suggest that in the context of sporting teams, public health implications could be taken into account when deciding on the unwise recruiting and redundancy of players (highlighting the importance of better management of resources like scouting, assistant coaches' expertise, budgetary limits, and leagues decentralization).

The established significance of microenvironmental factors in the epidemiology of H1N1 is confirmed and essentially extrapolated into the context of professional basketball.

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Competing interests: The authors declare that they have no competing interests.

Keywords: H1N1 virus, influenza, epidemiology, pandemic, crowding index.

SUMMARY

Although influenza may be propagated in innumerable occasions and daily situations involving exposure, basketball may create many chances for close contact in which influenza could spread. This study aims to quantify and assess the impact of the 2009 H1N1 influenza pandemic among professional basketball players. A multi-step strategy was followed to gather the relevant data during the 2009-10 basketball season. Possible risk factors were recorded; logistic regression was performed to assess the impact of the former. Where data were only available in the press, cases were also verified by subsequent communication with the national basketball federations. Relevant data were available for 18 countries (218 teams, 3,024 players). In all, 52 H1N1 cases in 19 teams were reported. A larger number of players presented as a risk factor for the emergence of H1N1 cases to a borderline extent (Odds Ratio, OR=1.19, 95% CI: 1.00-1.41, p=0.056). A borderline association also implicated the population of the city-basis (OR=1.01, 95% CI: 1.00-1.02, p=0.094). On the other hand, no significant association with risk of H1N1 emergence was demonstrated regarding latitude and longitude of the city-basis.
Even in environments where the best possible preventive and other medical care is provided influenza continues to be a threat. The microenvironment (crowding index, players per team) seemed to represent the most meaningful predictor regarding H1N1 emergence in a basketball team.

RIASSUNTO

Benché siano innumerevoli le occasioni e le situazioni del quotidiano che, implicando una esposizione, favoriscono il diffondersi dell'influenza, il gioco della pallacanestro può creare molte possibilità di contatti stretti che facilitano la trasmissione dell'influenza. Questo studio è stato condotto per quantificare e valutare l'impatto della pandemia influenzale da H1N1 del 2009 tra giocatori professionisti di pallacanestro. Una strategia multifase è stata adottata per raccogliere dati inerenti durante la stagione di pallacanestro 2009-2010: i possibili fattori di rischio sono stati registrati e, per determinarne l'impatto, è stata effettuata un'analisi di regressione logistica. Laddove i dati disponibili erano solo quelli comunicati a mezzo stampa, i casi sono stati verificati sulla base di successive comunicazioni intercorse con le federazioni nazionali di pallacanestro. Dati rilevanti sono stati disponibili per 18 paesi (218 squadre, 3024 giocatori).

Complessivamente, sono stati riportati 52 casi di influenza da H1N1 in 19 squadre. Un maggior numero di giocatori presentava un fattore di rischio per l'insorgenza di H1N1 in misura borderline *(*Odds Ratio, *OR=1,19; IC95%: 1,00-1,41; p=0,056). Una associazione* borderline *ha interessato anche la popolazione della* city-basis *(OR=1,01; IC95%: 1,00-1,02; p=0,094). D'altro canto, non è stata dimostrata nessuna associazione significativa tra il rischio di emergenza di H1N1 e i parametri di latitudine e longitudine della* city-basis.
Anche negli ambienti dove la prevenzione e le cure mediche sono le migliori possibili, l'influenza continua a rappresentare una minaccia. Il microambiente (indice di affollamento, giocatori per squadra) si è rivelato il fattore predittivo più significativo per l'emergenza di influenza da H1N1 in una squadra di pallacanestro.

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