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Reduced social distancing and face mask wearing at massive soccer-related gatherings did not affect daily COVID-19 infections in Argentina

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ABSTRACT

AIMS. To determine the contribution of social distancing and face mask wearing in the prevention of COVID-19 infections in Argentina.

METHODS. Attendance to the funeral of ex-soccer star Diego Maradona was estimated by the area occupied by the mourners and their density. The people congregated to celebrate the America's Cup victory was deduced mainly from TV ratings. The proportion of individuals wearing or not face masks was calculated from photographs taken at both events. The COVID-19 epidemiological data used was released by the Argentinean Ministry of Health from March 3rd 2020 to August 31st 2021.

RESULTS. We estimated that Maradona's funeral was attended by approximately 250,000

mourners. Approximately 5,083,958 followed by television the America's cup final in Buenos Aires alone. Extrapolating to the whole country suggests that over 4 million individuals congregated in person to celebrate the victory. The percentage of individuals not wearing face masks at the funeral was $54.0\% \pm 5.2\%$ and at the soccer victory celebrations $84.5\% \pm 6.9\%$, both estimates with a confidence of 99%. Daily COVID-19 infections in Buenos Aires remained at less than 5,000 per day during 30 days before- as well as during 24 days following-the funeral. New infections in Argentina remained less than 21,000 during 10 days before as well as 30 days following the soccer cup celebrations.

CONCLUSIONS. Considering that SARS-CoV-2 median incubation is 5.1 days, the time periods following Maradona's funeral and the America Soccer Cup celebrations provided ample time for COVID-19 to flare up if significant contagion would have proliferated amongst the crowds. The lack of an increase in COVID-19 infections after two independent and large gatherings with people in close proximity and limited wearing of face masks, raises questions about any beneficial effect of social distancing and of mask wearing during the pandemic.

INTRODUCTION

The non-pharmaceutical public health policies implemented by most countries in response to COVID-19 included mandating social distancing (usually 6 feet or 2 meters) and wearing face masks (generally made of a single layer cloth). In addition, public health measures taken in Argentina during 2020 (from March 19, 2020 to December 31, 2020) resulted in 119 days of

strict nation-wide lock-down, 166 days of less restrictive lock-downs, cancellation of public and family gatherings as well as closure of international borders, schools, and commerces.¹ On November 26, 2020, the National Government temporarily lifted all of the restrictions under General Decree # 936/2020 which authorized three days of national mourning for the death of Diego Maradona (an ex-soccer star worshiped in Argentina).² The funeral included the viewing of the casket by mourners on November 26th and Maradona's burial the following day on November 27, 2020. The sudden lifting of stringent measures provided an uncommon opportunity to study any increase in COVID-19 infections due a massive gathering of people. Another opportunity to analyse the effect of large gathering on the pandemic arose seven months after Maradona's funeral.

After 28 years without victory in spite of reaching the finals seven times, the Argentina's soccer national team conquered the America's Soccer Cup (Copa América de Football) on July 10th, 2021. In all corners of Argentina, the spontaneous crowds celebrating the victory were of considerably magnitude³⁻⁷.

In addition to social distancing and use of face masks, at the time of Maradona's funeral and the Americas cup celebrations were in place the restrictions listed in Table 1.

Table 1: Comparative restrictions between Maradona's funeral and Soccer Cup celebrations

Public Health Measures	Details	November 2020	July 2021
Group Traveling	Sport teams, graduation classes, tourism, etc.	Prohibited	
Family Gatherings	More than ten people at particular residences	Prohibited	
Public Transportation	Limited to essential personnel	Prohibited	
Social Gatherings Indoors	Cultural, religious, social or recreational	Prohibited	
Indoor Activities	Cinemas, theaters, gymnasiums, clubs	Prohibited	
Restaurants	Allowed home delivery and pick-up)	Closed between 23:00 and 06:00	
Labor and Services Indoor	Ventilation following special protocols	Operation at 50% capacity	
National Borders		Open	Closed
Curfews	Enforced public curfew from 0:00 to 06:00	Lifted	Imposed

By comparing the infection rates in Argentina before and after the two massive gatherings, we expected to estimate the contribution of social distancing and mask wearing to the control or delay of the pandemic. Our findings surprised us.

METHODS

The policies implemented in Argentina to control COVID-19 were those published daily by the Ministry of Health of Argentina from March 3rd 2020 to August 31st 2021.⁸ The epidemiological data corresponding to COVID-19 for Argentina were confirmed by the compilation made by the John's Hopkins' Center for System Sciences and Engineering.⁹

According to WHO recommendations, face masks must cover both, nose and mouth to be considered adequate¹⁰; thus, people at both events without face masks or those covering only their mouth were scored as not wearing a mask. The compliance of mask wearing at the funeral

of ex-soccer star Diego Maradona and during the celebrations of America's cup victory was estimated from different photographs posted in the internet by various sources. Thirty-six of the online photographs that were taken during the two-day funeral had enough definition to score accurately 329 persons as either wearing face mask or not. Face mask wearing during America's Cup celebrations was performed on 348 recognizable faces from 18 independent photos taken during the event at various locations. The proportion of persons wearing or not face mask was determined in each photograph, the standard deviation was calculated among all images and the level of error of the face mask wearing mean was reported with a confidence of 99%, obtained by input into a sampling size calculator the number of scored faces and the estimated crowd sizes of each event.¹¹

The number of people attending the funeral of Maradona was calculated by the area occupied by the crowd and the density (people per square meter) obtained from photographs of the event. We approximated the population celebrating the America's Cup victory from the TV ratings reported for the final match.¹²

RESULTS

Funeral of Maradona: News reports, as well as aerial photographs available online, confirm that the mourners -waiting to pay their respects- crowded along 25 city blocks surrounding the national palace where the casket was located.^{13,14} The length of city blocks in Buenos Aires are approximately 100 meters long and the streets 10 meters wide, suggesting that the crowd

occupied approximately 25,000 square meters. Our analysis of available photographs from the event (see below) suggest that in at least 20 central blocks, the crowd was shoulder to shoulder (see Inset A in Figure 1), at a density of 5.5 persons per square meter. Additionally, a density of 3 persons per square meter could be estimated in the remaining 5 blocks at the periphery.

These estimates indicate an attendance of approximately 125,000 mourners to the viewing and a similar number next day to the burial.



Figure 1: Funeral of Diego Maradona in Buenos Aires, Argentina. The main panel depicts mourners waiting to pay respects in front of the casket. Inset A shows an elevated view of the crowd along a city block. Inset B presents the number of COVID-19 daily infections reported by government sources in the capital city of Buenos Aires (red line), its provincial suburbs (green line) or corresponding to national figures (blue line)

The compliance of mask wearing at the largest public gathering in Argentina during 2020 was

estimated from ninety-eight different photographs taken at the funeral of ex-soccer star Diego Maradona and posted in the internet by various sources. Thirty-six of the online photographs that were taken during the two-day funeral had enough definition to determine the extent of face mask wearing. On these photographs we could accurately score 329 persons as either wearing face mask or not. The average of the percentage of individuals not wearing face masks at the funeral (or wearing them improperly) in the photographs (N=36) was 54.0% and the standard error of the percentage was 2.0%. The total number of scored individuals in the 36 photographs of the funeral was 611. This sampling size of a population estimated at 250,000 (during the days of viewing and of burial) assigns to the average of 54% of the persons attending the funeral and not wearing face mask a 5.2 % error with a confidence of 99%. Furthermore, extensive shouting and singing occurred throughout the funeral highlighting the opportunity for bioaerosol emission and concomitant person-to-person-transmission.

We investigated whether contagion during the funeral had an impact on COVID-19 daily infections reported in: i) the whole country as released daily by the Ministry of Health of Argentina.⁸ , ii) the city of Buenos Aires (where the funeral occurred) and iii) the suburban Province of Buenos Aires from where many mourners came.¹⁵ The epidemiological data corresponding to COVID-19 in Argentina was compared and confirmed by the compilation made by the John's Hopkins' Center for System Sciences and Engineering.⁹

Inset B of Figure 1 shows that national COVID-19 infections did not increase during the dates of the funeral. The local epidemiological data depicted in the same graph indicates that daily

infections in Buenos Aires City remained at less than 5000 new infections per day during 30 days before the funeral as well as during 24 days following the funeral (until December 19, 2020).⁸ Similarly, daily infections did not increase in suburban Buenos Aires Province.

America's Soccer Cup celebrations:

There is no available estimation of the total number of persons spontaneously celebrating the America Cup victory in every corner of Argentina. However, news reports as well as aerial photographs available online agree in that minutes after the end of the soccer final match, crowds of thousands people begun gathering to celebrate the victory in every corner of the country including Buenos Aires, every major city such as Rosario, Cordoba, Mar del Plata, Salta, Mendoza, Misiones, Tucuman, Santa Cruz, Corrientes, Catamarca, Entre Rios, Tierra del Fuego and even in Base Marambio in the Argentinean Antarctic sector.³⁻⁷

One of the most photographed of the gathering places was The Obelisk (see Figure 2) where people crowded at least two blocks before and another two pass the Obelisk through 9 of July avenue (200 meters wide) and Corrientes Avenue (50 meters wide) (see photo 2A) occupying at least 40,000 square meters. At a minimal density of 3 persons per square meter, the crowd celebrating victory only at the Obelisk must have been no less than 120,000. In all the places throughout Argentina were people congregated to celebrate, the images and the press reports were qualitative with imprecise numbers and area coverage but no number estimates were available. We approximated the population celebrating the America's Cup victory from the TV

ratings reported for the event. The TV rating for watching the America's Cup on 2021 in Capital (Buenos Aires city) and Greater Buenos Aires (GBA) was 52.53%.¹²

A one point of TV rating represents 1% of the target audience. There are 3,070,600 homes in Buenos Aires city and GBA with 9.678.200 potential viewers between 4 a 99 years of age. Thus, one point rating in Buenos Aires city and GBA corresponds to 30.706 homes and 96.782 individuals. Therefore, a TV rating of 52.53% indicates that were approximately 5.083.958 viewers following the match by TV in Buenos Aires and GBA.

It is safe to extrapolate a similar TV rating to all Argentina considering the passion for soccer in the provinces. Using a population figure for Argentina of 45.5 million¹⁶, nearly 20 million of Argentineans must have watched the final match of the America's Cup.

Everybody that the authors know come out of their homes to celebrate (personal communications) but certainly the sick, the very old and the very young could have stayed indoors. No matter what fraction of the nearly 20 million TV viewers gathered in celebration, the crowds were considerable. A conservative assumption would be that at least one-in-five of the people following the international match on TV gathered after its ending for rowdy celebrations of the national team's victory. This conservative assumption still indicates that at least 4 million people gathered in public centers of celebration in July 2021.



Figure 2. Soccer World Cup celebrations in largest cities of Argentina. Insets A, B C and D shows elevated views of the crowd in Buenos Aires, Rosario, Cordoba and Salta, respectively.

We performed an analysis of face mask wearing during America's Cup celebrations similar to that described for Maradona's funeral. Such an analysis of 348 recognizable faces (in 18 independent photos at various locations) revealed that $84.5\% \pm 17\%$ of the participants in the Americas cup celebrations did not wear face masks. This sampling size ($n=348$) of a population estimated at over 4 million across the country (see above) assigns to the average of 84.5 % of the persons celebrating the soccer victory and not wearing face mask a 6.9 % error with a confidence of 99%. The continued chanting and shouting of people in close proximity during many hours of

celebrating the Americas cup victory throughout the evening and night of July 10, 2021 should have enhanced the opportunity for SARS-Co V-2 contagion. We investigated whether contagion during the world cup celebrations had an impact on COVID-19 daily infections reported in: i) the whole country (Figure 3A), ii) the nation's capital of Buenos Aires, and iii) large cities such as Rosario and Cordoba (Figure 3B).

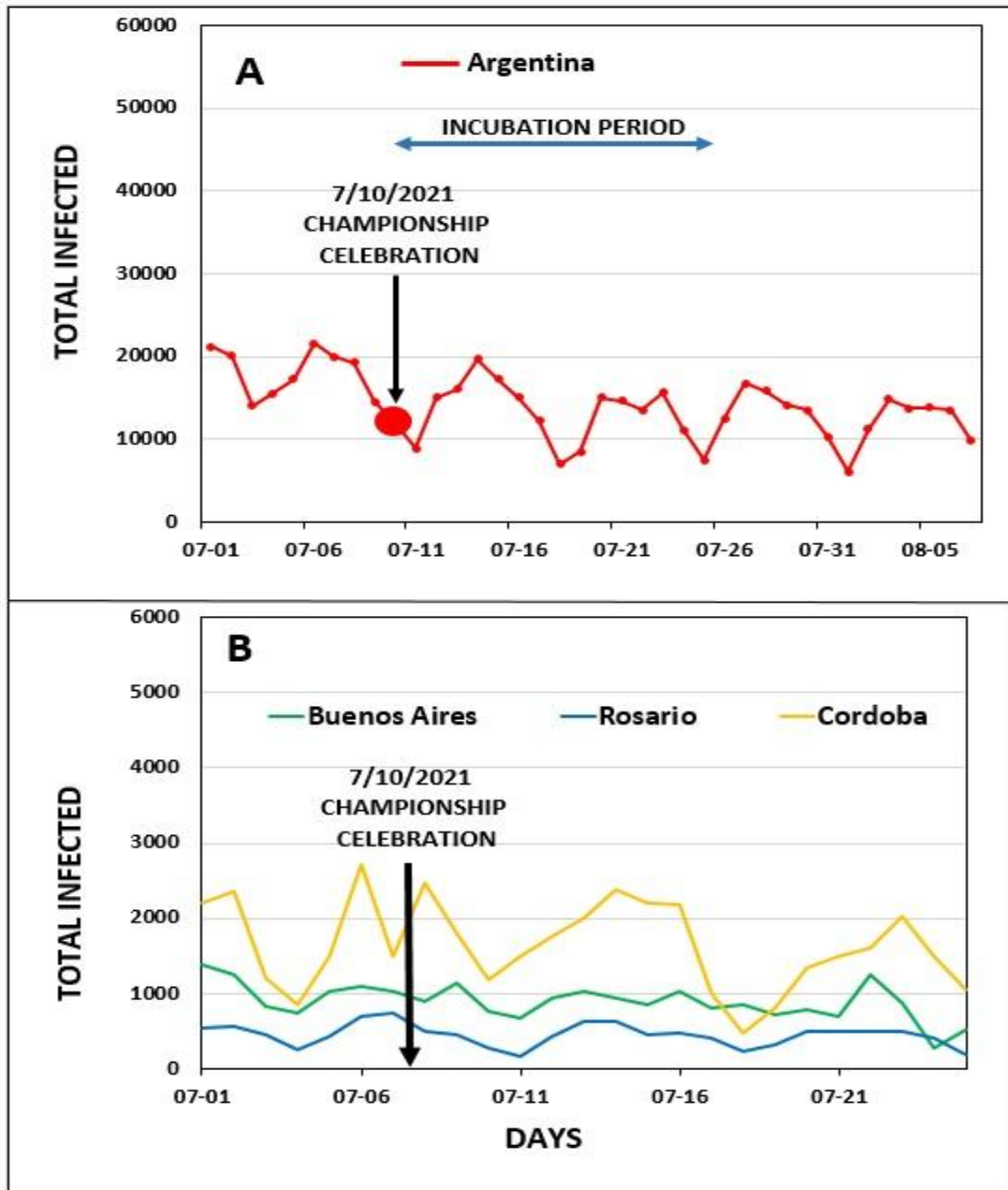


Fig. 3. COVID-19 Infections. Panel A presents the number of daily COVID-19 infections reported by government sources in the nation (red line), whereas Panel B shows the data for the capital city of Buenos Aires (green line), Rosario (blue line), Cordoba (yellow line) relative to the date of the Soccer Cup celebrations (vertical line).

Panel A of Figure 3 shows that national COVID-19 infections remained relatively stable with a slightly decreasing trend between July and August 2021. The local epidemiological data⁸ depicted in the same graph indicates that daily infections in Argentina remained at less than 21,000 new infections per day during 10 days before the celebrations as well as during 30 days following the gatherings. Similarly, daily infections did not increase in Buenos Aires, Rosario, nor Cordoba (Fig 3B). Relatively stable number of infections before and after the date of the America Cup celebrations was also reported in other Argentinian cities (data not shown).

DISCUSSION

The funeral of Diego Maradona in Buenos Aires with more than 200,000 mourners on November 26 and 27 appears to have been the largest gathering of people anywhere in the world during 2020. Similarly, the celebrations of the America's Soccer Cup victory in all major cities of Argentina, amounting to several million nation-wide might have been the largest gathering of people breaching COVID-19 government restrictions during 2021. Studying both events allows unique analysis and conclusions.

The data being presented demonstrates that a gathering of more than 200,000 people (Figure 1), all crowded within a relatively small area (Figure 1 Inset A) where approximately half of which did not wear face masks, failed to increase daily COVID-19 infections (Inset B) during 24 days following-the funeral (at least until December 19, 2020). Similarly, gathering of at least four million nation-wide after the soccer cup victory where nearly 84% of people did not wear

face masks failed to increase COVID-19 infections across Argentina 30 days after-the celebrations (Figure 3).

Considering that SARS-Co V-2 median incubation period is 5.1 days¹⁷ and 97.5% of those who develop symptoms will do so within 8.2 to 15.6 days of infection; the 24 day period following Maradona's funeral and 30 days after the America Soccer Cup celebrations provided ample time for COVID-19 to flare up if significant contagion would have proliferated amongst the crowds.

The vaccination campaign in Argentina started December 29, 2020.¹⁸ Thus, nobody was vaccinated in Argentina during Maradona's funeral in November of that year. Conversely, during the America's Cup celebrations, 43% of Argentina's population had at least one dose and 11% had two doses.¹⁹ Thus, similar absence of any increase in infections after crowding and limited face mask wearing at two large gatherings cannot be ascribed to vaccination since during Maradona's funeral nobody was vaccinated.

The findings reported here are in general agreement with previous studies indicating that infectious micro droplets can reach distances of 12.5 meters (over 40 feet).²⁰ Therefore, the generally imposed social distancing of 2 meters (6 feet) should result ineffective as indicated by our findings.

The lack of a protective effect of relatively inexpensive single cloth face masks can be understood by considering that the M50 series military mask (officially known as the US-Joint Service General Protective Mask) used previously by one of the authors (JLS) required exact

face fitting, extensive testing for air leaking, and cost \$250 excluding research and development.²¹⁻²² In contrast to the considerable effort (ongoing since the First World War) to protect military personnel from germs and toxins, the choice of single cloth face masks, loosely fitted and costing less than a dollar, should be expected to have the negligible protective effect observed in our comparative analysis.

The lack of an impact on COVID-19 infections of large crowds with people in close proximity and limited wear of face masks, originally observed after Maradona's funeral and confirmed 7 month later by analysis of the America Soccer Cup celebrations, raises questions about the beneficial effect of the generally prescribed social distancing (6 feet or 2 meters) and of (single cloth) mask wearing during the pandemic. In any case, the burden of proof should fall on proving the benefit of any obligatory policies and not on demonstrating their irrelevance. The analysis reported here should be considered by countries mandating mask wearing and/or social distancing to control either COVID-19 or future pandemics to come.

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Author contribution: *Dr. Aquilano gathered data from the Health Ministry and other sources in Argentina and produced the graphs. Dr. Sagripanti drafted the manuscript and analyzed the data. Contribution was 50% by each author.*

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