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Research paper

Air travel in a COVID-19 world: Commercial airline passengers' health concerns and attitudes towards infection prevention and disease control measures

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Abstract *Background:* COVID-19 and its associated travel bans have reduced international passenger traffic by over 80% below 2019 levels. If airlines are to resume flying at commercially sustainable levels, they must work to restore passengers confidence and sense of security. This study examined commercial airline passengers' health concerns and attitudes towards infection prevention and control measures for travel health and safety in the current COVID-19 global pandemic.
Methods: A cross-sectional study was conducted inviting adult members of 39 frequent flyer groups across three social media platforms to participate in an online survey.
Results: A total of 205 respondents completed the survey. The majority (75.6%) reported feeling 'somewhat' to 'extremely concerned' about contracting an infectious disease while flying, particularly respiratory-related. Few (9.8%) reported perceiving their health as an 'essential priority' for their preferred airline. Most respondents agreed airlines should provide complimentary hand sanitisers (86.8%), sanitary wipes (82.9%) and masks (64.4%) for passengers to use while flying as well as more information about preventing the spread of infections (90.7%), which would make the majority feel safer to fly.
Conclusion: COVID-19 has extensively challenged the air travel industry. Passengers have signalled that they expect more from airlines, and that they would actively engage in additional infection prevention and disease control measures while flying. Airlines must ensure passengers about the steps taken to minimize travel-associated risks, and their commitment

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towards passengers' health and wellbeing, in order to rebuild consumers' confidence in the recovery of the air travel industry.

Highlights

- The COVID-19 pandemic challenged the air travel industry like never before.
- Passengers are significantly concerned about the spread of infection while flying.
- Airlines must ensure passengers they are minimising risks of spread of infections.
- Passengers are calling for additional IPC measures to engage with while travelling.
- Rebuilding consumers' confidence is key for the recovery of the air travel industry.

Introduction

Prior to COVID-19 travelling by air had never been easier or cheaper [1,2]. More than 4.5 billion people travelled by air worldwide in 2019 [3]. The accessibility, safety and efficiency of global air travel has, however, brought challenges for the prevention and control of infectious diseases [4,5]. Long-haul travel allows passengers to move worldwide within periods of time shorter than the incubation of many infectious diseases [6]. Air travel has also fuelled the global spread of antimicrobial resistance (AMR), with over 20% of travellers returning from AMR endemic areas carrying resistance [7]. SARS-CoV-2 spread worldwide and was declared a global pandemic [8] in less than 3 months, driven principally by the movement of infected individuals by air [9—12].

The emergence of COVID-19 and its associated travel bans have reduced international passenger traffic. As of 8 October 2020, 1.2 billion passengers have travelled worldwide [13], compared to the over 4.5 billion in 2019 [3,14]. Many airlines have folded or significantly reduced their operations in an attempt to mitigate the worst financial crisis in the history of air travel industry [15,16]. The International Air Transport Association (IATA) conducted a survey of 4700 recent air travellers, to examine the impact of COVID-19 on passengers' perceptions of the travel safety and their expected travelling behaviours. It concluded that 36% of respondents would at least wait six months before considering travelling by air, with an additional 14% reporting they would not travel before a year or more from the moment the pandemic would show a global decline [17]. The IATA study did not explore comprehensively suggested infection prevention and disease control measures that commercial passengers might engage in to reduce their risk of exposure to an infectious disease.

Until recently, travel health advice provided to commercial airline passengers focuses mostly on managing oedema, jet lag, dehydration, and the risks of venous thromboembolism (VTE) [18,19], and not on preventing the spread of infectious disease [1,2]. Prior to COVID-19 few commercial passenger airlines provided passengers with infection prevention and disease control advice, with very limited information in their inflight magazines [2] and websites [1]. COVID-19 has highlighted again the need to better understand commercial airline passengers' concerns and perspectives on the safety of flying with respect to infectious diseases. If airlines are to resume flying at commercially sustainable levels, they must demonstrate to governments and public health regulatory agencies that they have implemented appropriate infection prevention and disease control measures that make it safe for passengers to fly. Similarly, they must demonstrate to passengers that these measures make it safe for them to fly, thus restoring their confidence on the safety of air travel [20]. Increasing consumers' confidence is likely to facilitate the airlines' commercial viability in a post pandemic era. This study examined commercial airline passengers' health concerns and attitudes towards infection prevention and disease control measures for travel health and safety in the current COVID-19 global pandemic.

Methods

Study design

A cross-sectional observational study using an online survey across Facebook™, Twitter™ and LinkedIn™ social media platforms.

Study population

Adult (aged 18 years and over) members of 39 frequent flyer groups within Facebook™, Twitter™ and LinkedIn™ were invited to participate. To be eligible, participants were required to be proficient in English. Consent to participate was based explicitly on submission of the survey. Human research ethics approval was sought and granted for this study (HREC 2020/086).

Data collection and analysis

A specific page titled 'Travel Health Protect' (@TravHealthProt) was built within each of the three social media platforms to promote participation among members of frequent flyer groups. A voluntary, anonymous online

survey was developed with the Research Electronic Data Capture (REDcap™) software by a panel of experts in travel medicine and health, infectious diseases, and infection prevention and disease control. The survey included Likert scale, multiple choice, dichotomous and open answer questions related to i) respondents' demographics; ii) passengers' current flying habits; iii) passengers' health concerns with air travel and existing infection prevention an disease control behaviours; and iv) passengers' engagement with additional infection prevention and disease control measures. No questions were mandatory. The survey was pilot tested with modifications to wording and format to improve clarity and readability. The final survey (see supplementary material) was distributed as a URL link to members of the frequent flyer social media groups during the months of June–August 2020. Once closed, responses were downloaded, cleaned, and analysed in IBM SPSS 26®. Individual questions with no response were treated as missing values, and the denominator for those questions adjusted accordingly. Descriptive statistics were used to analyse the data. Free text responses were imported into Microsoft Excel and were analysed using conventional content analysis technique [21]. These qualitative data provided further explanatory insight into the descriptive information.

Results

Demographics

In total 205 individuals completed the survey, of which 72.7% (n = 149) identified as female and 26.3% (n = 54) as male. Respondents' age ranged from 18 to 79 years old (mean 47.01, SD 15.43), and reported living in various countries and regions including Australia (44.4%, n = 91), United States of America (43.9%, n = 90), South America (5.9%, n = 12), Europe (3.9%, n = 8), Asia (0.98%, n = 2) and the Middle East (0.5%, n = 1).

Current flying habits

The vast majority of respondents (89.8%, n = 184) reported having a preferred airline when travelling by air. In total 26 different preferred airlines were reported, of which 22 are international as well as domestic commercial carriers and the remaining 4 were domestic-only. More than half of the respondents (68.1%, n = 139) reported being a member of at least one airline frequent flyer program. The respondents were asked about how often they took a domestic and/or international flight during 2019, as illustrated in Fig. S1. A majority (83.9%, n = 172) reported taking domestic flights during 2019, of which 71.7% (n = 147) reported flying a few, once or twice a year. In terms of international flights, over half (61.5%, n = 126) of the respondents reported flying internationally during that year, with 58% (n = 119) reporting one or two international flights. Few respondents (3.4%, n = 7) reported flying internationally once and up to three times a month.

Passengers' health concerns about air travel and existing infection prevention and disease control measures

Respondents were asked how concerned they were about contracting an infection while travelling by air. More than half (61%; n = 125) reported being moderately (21.5%; n = 44) or extremely concerned (39.5%; n = 81). Of those reporting being 'extremely concerned', more than half (55.6%, n = 45) were over 50 years old and only 11.9% (n = 9) were under 30 years of age. Gender-wise, the majority (84%, n = 68) of extremely concerned respondents were females. Few respondents (9.8%, n = 20) reported having no concerns, as illustrated in Fig. 1.

We asked respondents to list at least one, and up to five, infection(s) they were concerned about contracting while travelling by air. In total there were 308 responses, which when collated resulted in 29 different infectious diseases. Of these 29, 13 were respiratory-related, accounting for 89.6% of the total responses (n = 276). The top three infectious diseases, namely COVID-19, Flu and common cold, comprised 83.4% (n = 257) of the total responses, as illustrated in Fig. 2.

Respondents were asked about their existing infection prevention and disease control measures and behaviours. More than half (65.4%, n = 134) reported being vaccinated for influenza in 2019. Over half of them reported never carrying their own alcohol-based hand sanitisers (52%; 106/204) or sanitary wipes (54.1%; 111/205) on past flights. Female respondents were more likely to carry alcohol-based hand sanitisers (81.6%, 80/98) or sanitary wipes (77.7%,73/94) while flying. Respondents were also asked about how often they wore a face mask prior to COVID-19 to protect themselves from infectious diseases while travelling by air, with the vast majority (83.4%, n = 171) reporting never wearing a face mask. Few (7.3%, n = 15) indicated they always wore one while travelling, as illustrated in Fig. S2.

Respondents were asked how much of a priority their general health is to them when travelling by air. The vast majority (76.6%, n = 157) reported it either as high priority (40%, n = 82) or essential (36.6%, n = 75). They were also asked how much of a priority their health is with respect to contracting an infection while travelling by air, of which 41.5% (n = 85) reported it as 'essential' and 38% (n = 78) as 'high'. In regard to the extent to which their preferred airline prioritises passenger health and wellbeing with respect to infectious diseases, few respondents (9.8%, 20/205) reported perceiving their health to be an 'essential priority' for their preferred airline. Further details on these variables are summarised in Table S1.

Respondents reported their level of satisfaction with their preferred airline's commitment to keeping them safe from infectious diseases when travelling by air. Almost half of them (49.8%, n = 102) indicated being 'unsure' about their preferred airline's commitment on this matter. While 20.5% indicated feeling "dissatisfied' (14.6%, n = 30) and 'very dissatisfied' (5.9%, n = 12), as illustrated in Fig. 3.

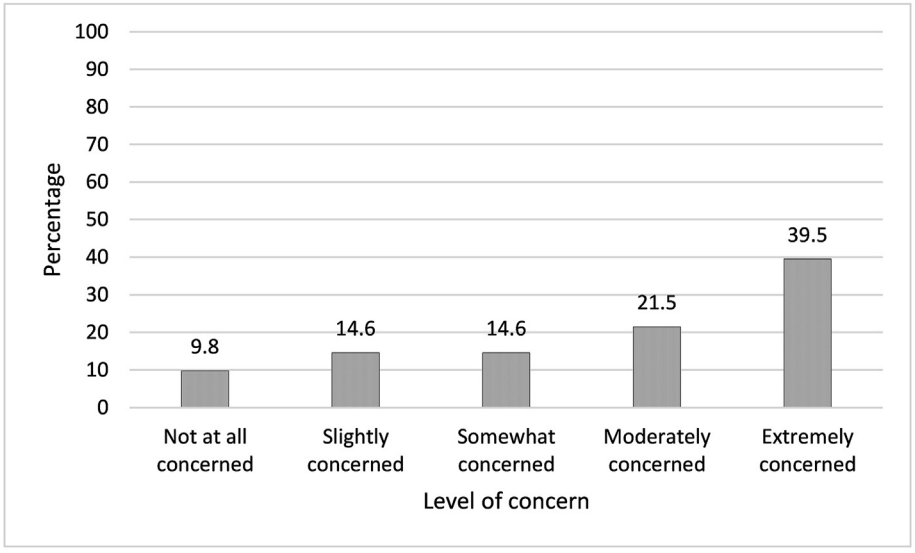

Figure 1 Respondents' level of concern about contracting an infection during air travel.

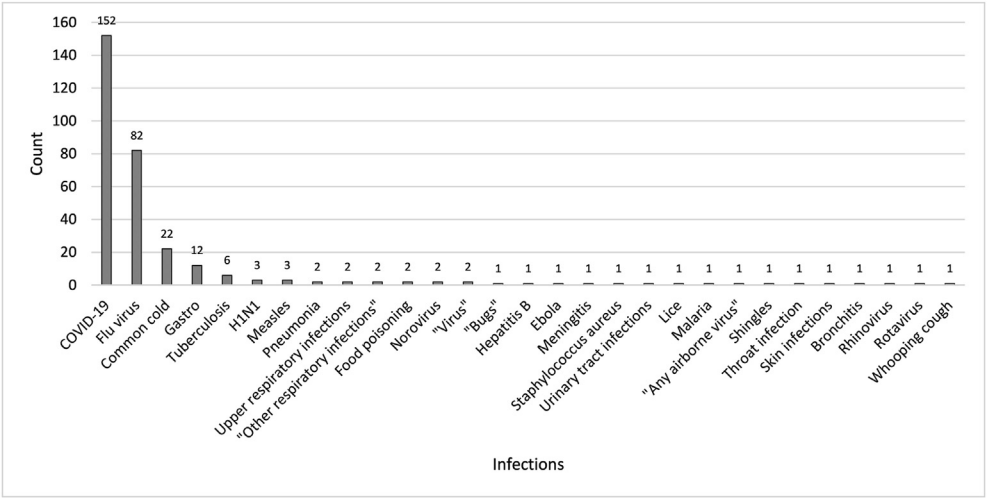

Figure 2 Infection(s) that participants reported being concerned about contracting during air travel.

We examined respondents' level of satisfaction about the information provided by their preferred airlines about risks of infection while flying. The vast majority (73.1%, n = 150) reported feeling 'unsure' (46.8%, n = 96), 'dissatisfied' (18%, n = 37) and very dissatisfied (8.3%, n = 17), with some respondents (26.8%, n = 55) reporting being 'satisfied' (18.5%, n = 38) or 'very satisfied' (8.3%, n = 17).

Passengers' engagement with additional infection prevention and disease control measures

Respondents were presented with a range of options about possible infection prevention and disease control measures to improve travel health and safety. The overwhelming majority indicated airlines should provide complimentary alcohol-based hand sanitisers (86.8%, n = 178) and sanitary wipes (82.9%, n = 170). When asked about how often they would use the complimentary alcohol based-hand sanitiser, if provided by free of charge, 65.4% (n = 134) reported they would use it every time they fly, while 23.4% (n = 48) would use it almost every time and 7.8% (n = 16) would use it sometimes. Similarly, if sanitary wipes were provided for free, over half (65.4%, n = 134) of the respondents indicated that they would use them every time they fly, while 20% (n = 41) would use them almost every time and 10.2% (n = 21) would use them sometimes to clean their hands and cabin surfaces. Few respondents (1.5%, n = 3 and 2%, n = 4) reported they would never or almost never use alcohol-based hand sanitiser or sanitary wipes respectively.

Respondents were asked whether masks should be provided free of charge if mandated for flying, to which more than half (64.4%, n = 132) of respondents said yes. Regarding frequency of use, over half (58.5%, n = 120) of the respondents indicated they would wear a face mask for every flight, followed by 16.6% (n = 34) stating they would

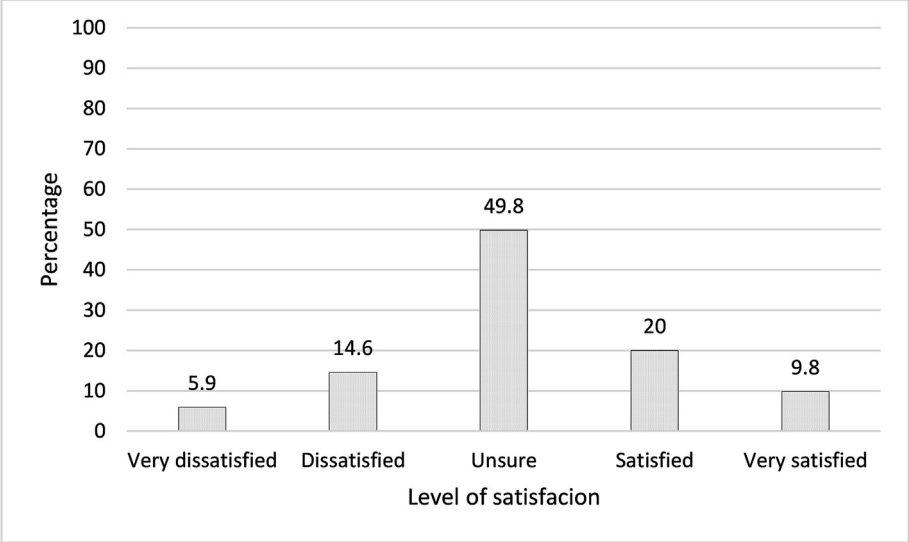

Figure 3 Respondents' level of satisfaction with their preferred airline's commitment to keeping them safe from infectious diseases while flying.

use it almost every time or sometimes (9.3%, n = 19). Some respondents (15.6%, n = 32) reported that they would never wear a mask (9.3%, n = 19) or almost never (6.3%, n = 13), even if provided for free. We then asked the respondents whether being given alcohol-based hand sanitisers, sanitary wipes and/or face masks by their preferred airline would make them feel safe to fly, as summarised in Table 1. More than half reported that being given alcohol-based hand sanitiser (61.4%, n = 126) or sanitary wipes (67.4%, n = 138) would make them feel 'somewhat' to 'extremely safe' to fly. The majority (83.4%, n = 171) reported they would to 'some extent' feel safe to fly if all passengers and staff were required to wear face masks while flying.

We asked the respondents whether airlines should provide more information about how to prevent the spread of infection to their passengers, and if so, by which means. The overwhelming majority (90.7%, n = 186) agreed that airlines should provide more information on this topic. The majority (70.2%, n = 144) reported a preference for this information to be sent by email or SMS message together with flight-related documentation followed by distributing information via inflight television programming (52.2%, n = 107), as illustrated in Table S2.

Table 1 The effect of complementary hand hygiene products and face masks on passengers perceptions of 'feeling safe to fly'.

Likert Scale	Alcohol-based hand sanitiser % (n)	Sanitary wipes % (n)	Face masks % (n)
Not at all safe	9.8% (20)	8.7% (18)	7.8% (16)
Slightly safe	28.8% (59)	23.9% (49)	26.3% (54)
Somewhat safe	30.7% (63)	28.3% (58)	33.2% (68)
Moderately safe	23.9% (49)	29.8% (61)	23.9% (49)
Extremely safe	6.8% (14)	9.3% (19)	8.8% (18)
Total	100% (205)	100% (205)	100% (205)

Respondents were asked whether other specific measures would influence their perceptions of safety. Some airlines have introduced additional health and safety measures during check-in, onboarding, and flight to improve travel health and safety. Respondents were asked how useful these initiatives were, with a link to a currently available program implemented by Air Canada (CleanCare+) as example. Of 204 respondents, the majority (65.7%, n = 134) reported this initiative was either 'extremely useful' (33.8%, n = 69), 'moderately useful' (31.9%, n = 65) or 'somewhat useful' (23.4%, n = 48). Few (10.7%, n = 22) reported it to be 'slightly useful' (7.3%, n = 15) or 'not useful at all' (3.4%, n = 7). By using a dichotomous question, respondents were asked whether the implementation of such a program by they preferred airline would make them feel safe to fly. The vast majority (74.6%, n = 153) agreed that implementation of such a program would make them feel safe to fly. With regards to blocking seats between passengers to maintain physical distancing, the majority (96.1%, 196/204) reported this strategy would make them feel 'slightly safe' (17.6%, n = 36), 'somewhat safe' (31.9%, n = 65), 'moderately safe' (33.8%, n = 69) or 'extremely safe' (12.7%, n = 26) to fly. Few respondents (3.9%, 8/204) reported that blocking seats between passengers would not make them feel safe to fly at all.

We also asked respondents to suggest other specific measures that would help them feel safe to fly, with five key themes emerging. First, many respondents (n = 23) suggested that *face masks should be mandatory for all passengers*, as exemplified by this respondent's comments: *"I'd like to see airlines require mandatory face masks for entire duration of the flight by everyone on board …"* (Respondent X). Second, many respondents (n = 18) suggested that *passengers should be physically distanced while flying*. For some passengers, this included

all aspects of the journey: *"More room between passengers when waiting, boarding, in seats, when disembarking and in the airport"* (Respondent A), with others particularly interested in the in-flight phase, as explained by Respondent M: *"I think that they should remove seats – fewer people per flight"*. Third, a number of respondents (n = 17) expressed concerns about in-cabin surfaces cleanliness, as reported by one of them: *"My only concern with flying is I don't believe that surfaces are cleaned between passenger contact. This is the only area of travel that concerns me and I believe needs to be significantly improved to make me feel safer"* (Respondent T). Fourth, some respondents (n = 16) suggested implementation of *pre-boarding COVID-19 testing and screening,* as reported by Respondent F: *"Rapid tests prior to taking the flight, temperature check to all passengers"*. Fifth, few respondents (n = 11) were interested in the *provision of information about in-cabin air quality filters and air disinfection,* as exemplified by respondent A: *"Proof of high-quality air filtration (HEPA and UV-C would be a minimum requirement for me"*.

Lastly, respondents were invited to provide any additional comments about potential risks of infection while travelling by air, which gave rise to five key themes. First, passengers wanted *cleaner aircrafts* (n = 12), which was also reported as a specific measure in the previous question. As one respondent said, *"Better cleanliness of the interior of the planes, e.g. arm rests and especially pull-down tables!"* (Respondent R). Second, some respondents (n = 10) with *comorbidities and other high-risk factors* reported being so concerned that they would not fly, as exemplified by this respondent's comment: *"I am high risk three ways so probably won't fly again until there is a vaccine for COVID-19. Maybe not even then"* (Respondent U). Third, few respondents (n = 6) were concerned about *poor passenger and staff hygiene*. As expressed by respondent W: *"I have seen a decline in general hygiene practices. I think training of staff and information for passengers could go a long way to improving people's behaviour in this pace. It's not 100% perfect but it could go a long way to reducing the spread …"* Fourth, there were few respondents (n = 5) who reported *not feeling safe to fly because of concerns about transmission of infectious diseases from asymptomatic passengers onboard,* as exemplified by this comment: *"I do not feel that is safe to fly now … I have caught too many colds on planes (and rarely catch them elsewhere) … But given how people with no symptoms can spread it, many contagious people could easily still make it on a flight"* (Respondent J). Finally, flying on a *fully booked flight with no physical distancing* was reported to be a significant risk for a few respondents (n = 4), as illustrated by remarks from Respondent H: *"Have travelled on [airline] four times since COVID. Some trips completely full flight with no ability to social distance with empty seat unless you wanted to purchase the empty seat"*. This was a particular concern given that some airlines indicated that their policy was not to fully book flights, as Respondent D explained: *"Disappointed they fully booked flights when web info said they would not fly at full capacity"*.

Discussion

This study examined commercial airline passengers' health concerns and attitudes towards infection prevention and disease control measures for travel health and safety. COVID-19 has had an unparallel economic impact on the global airline industry [22], as consequence of unprecedented global containment measures such as travel bans and border closures [23]. International commercial air travel passenger volumes for 2020 are down to approximately a quarter of those compared to 2019 [3,14]. COVID-19 has demonstrated firsthand how global air travel facilitates the spread of infectious diseases [24–27].

The results of our study show that frequent flyers have significant concerns about their health and wellbeing with respect to the threat of infectious diseases. Similar findings were reported by IATA's COVID-19 survey earlier this year, where 78.3% of frequent flyers respondents reported feeling 'very to somewhat concerned' with respect to COVID-19, across all stages of the travel experience [17]. Furthermore, and as reflected by some of our respondents, health determinants such pre-existing chronic illnesses or being an older traveller also play a fundamental role in regards to their level of concern around COVID-19 [28]. Moreover, the results from this study demonstrate that passengers want their preferred airlines to do more to improve their health and safety and that they are willing to engage, calling for measures such as complimentary kits with alcohol-based hand sanitisers, sanitary wipes, and face masks to all passengers, as well as more information about how to prevent and contain the risk of infection while flying. The importance of hand hygiene, masks and other measures in mitigating the spread of infectious diseases has been illustrated in this pandemic [29]. Over 80% of our respondents indicated that they would actively engage in using hand sanitisers or sanitary wipes, should these be provided by the airlines free of charge. However, by comparison, fewer respondents reported they would wear a face mask even if provided by their preferred airline. This difference is perhaps not surprising as face mask use by the general public, as a strategy to reduce the spread of COVID-19, has been controversial [30].

Some global commercial airlines including Air Canada [31], Qantas [32], Cathay Pacific [33] and United Airlines [34] have recently introduced programs enhancing preventive measures against the risks of infection for passengers, with their official websites showcasing infographics describing cleaning and disinfection protocols for frequently touched areas implemented amid COVID-19, along with recommendations for passengers to engage with while flying. The results from this study suggest that these kind of programs make passengers feel safer to fly, particularly the inclusion of information on implemented infection prevention and disease control measures added to the traditional travel health advice provided [35]. While IATA suggests that risk of in-cabin COVID-19 transmission is low [13], COVID-19 has spread globally because of the movement of infected individuals by air travel [9–12]. Moreover, the IATA COVID-19 survey concluded that 36% of respondents would at least wait six months before consid-

ering traveling by air, with an additional 14% indicating they would not travel before a year or more from the moment the pandemic shows a true global decline and 5% reporting no travel for the foreseeable future [20]. Until an effective vaccine becomes finally available, it is crucial that airlines implement pre-, during and post-flight infection prevention and disease control measures for both passengers and staff permanently to mitigate the effects of future pandemics which are considered inevitable.

This study has some limitations. It includes a small number of respondents which limits the generalizability of the results. It was not possible to calculate the total response rate as the size of the frequent flyer groups is not available. Additionally, the survey was only available in English, limiting participation from frequent flyers without English language proficiency. Notwithstanding, this data provides valuable contemporary insights on commercial airline passengers' health concerns and attitudes towards infection prevention and disease control measures for travel health and safety in the current COVID-19 global pandemic. COVID-19 has challenged the commercial air travel industry like never before. Airlines must ensure they actively minimise the risks of spread of infections among passengers. Passengers have signalled that they expect more from airlines, and that they would actively engage in additional infection prevention and disease control measures. Such measures are fundamental to rebuilding consumers' confidence in the recovery of the commercial air travel industry. With a vaccine some time away, commercial airlines need to better understand their passengers' concerns and perspectives about how safe it is to fly with respect COVID-19 and other infectious diseases and raise consumer confidence, if they are to be commercially viable.

Ethics

Human research ethics approval for this study was granted by The University of Sydney Human Research Ethics Committee (Approval 2020/086).

Authorship statement

RZS: Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Data Curation, Writing Original Draft, Writing Review and Editing, Project Administration. CSC: Formal Analysis, Investigation, Data Curation, Writing Original Draft, Writing Review and Editing, Project Administration, Manuscript submission. KR: Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Data Curation, Writing Review and Editing. CL: Formal Analysis, Data Curation, Writing Review and Editing. SN: Formal Analysis, Data Curation, Writing Review and Editing. All authors contributed to the final analysis and interpretation of the results. All authors contributed to the drafting of this manuscript and approved it for submission.

Conflict of interest

Professor Ramon Shaban is a senior editor of *Infection, Disease and Health* but had no role in the peer review or editorial decision-making process for this manuscript whatsoever. The authors declare no other conflicts of interest.

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Provenance and peer review

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Appendix A. Supplementary data

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