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RESEARCH ARTICLE

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A comparison of the public's use of PPE and strategies to avoid contagion during the COVID-19 pandemic in Australia and Germany

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Abstract

The SARS-CoV-2 or COVID-19 pandemic has raised public awareness around disease protection. The aims in this study were to recruit participants from Australia and Germany to determine their use of personal protective equipment and COVID-19 avoidance strategies using scales designed for this study. Principal components analysis with the Australian data revealed two factors in the Protection from Infection Scale, Self-Care and Protective Behaviors, and a single factor in the Infection Avoidance Scale, with each scale demonstrating strong internal reliability. Data from German participants were used to confirm the scales' structure using confirmatory factor analysis. A comparison of the two data sets data revealed that Australian participants scored higher overall on protection and avoidance strategies but at the item level there were several commonalities, including self-care behaviors people adopted to avoid contracting COVID-19. With no foreseeable end to this pandemic, it is important that follow-up studies ascertain whether the public continues to adopt high levels of PPE use and follows government advice or if pandemic fatigue sets in.

KEYWORDS
avoidance, COVID-19, infection control, pandemic, personal protective equipment (PPE), public, SARS-CoV-2

Key points

- Two scales were validated in relation to COVID-19: (1) Protection from Infection Scale and (2) Infection Avoidance Scale
- People from two different continents reflected high levels of adherence to adoption of infection protection and avoidance strategies
- Monitoring public adherence to these strategies over time is important in light of potential pandemic fatigue

1 | INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) or COVID-19 pandemic, to which some 150 million cases and over 3 million deaths were attributed at the end of April 2021 (Dong et al., 2020), is challenging health care systems worldwide. Health care workers dealing with patients with COVID-19 are protected from infection to some extent by their use personal protective equipment (PPE) as outlined in transmission-based precautions, used in addition to the Standard Precautions Guidelines (SP; Siegel et al., 2007). Although past adherence rates have often been described as suboptimal for the SP (Oh & Choi, 2019), the virulence and spread of the

COVID-19 pandemic has resulted in significant consciousness-raising around the need for PPE use. National and international guidelines have also emphasized the essential need for health care workers to universally adopt PPE (Centers for Disease Control and Prevention, 2020), as they "are likely to be in contact with patients and colleagues who have atypical, few, or no symptoms [of SARS-CoV-2] while still being highly contagious" (Bielicki et al., 2020, p. e262). But what of the general public and the strategies they adopt to avoid infection or community transmission of the disease which can also reduce the burden on health services?

Governments across the world have introduced community management strategies with the broad aim of slowing or stopping the community spread of the disease and prevent health services being overwhelmed by cases of COVID-19. The range of strategies implemented is multipronged and governments have relied on voluntary strategies as well as legally enforceable ones. These strategies include personal measures such as requirements that people wear some personal protection, such as face masks when in public places, that they voluntarily self-isolate if feeling sick or awaiting COVID-19 test results, and that they use cough etiquette and increased hand hygiene with soap and water or alcohol hand rubs (Department of Health and Human Services, 2020). In addition, community strategies include social distancing, such as mandating the physical distance between people, restricting the number of people allowed per square meter in public places such as shops and public transport, and canceling large gatherings (Seale et al., 2020). Often these measures are supplemented by increased environmental disinfection. In many countries, these measures have also been accompanied by government-enforced lockdowns, where citizens' individual freedom of movement was curtailed to prevent the spread of COVID-19 (Bo et al., 2021).

For the general public, the use of PPE is largely a new concept and there have been conflicting messages across the course of the pandemic about its use. While hand washing or sanitizing, social distancing, and social isolation are among the government-mandated criteria to be followed by the public, the WHO originally did not recommend the use of face masks for the community, based on what they argued was a lack of evidence that face masks prevent the transmission of respiratory viruses (Cheng et al., 2020; Stone et al., 2020). This failure to recommend the public's use of masks was despite the inclusion of cough etiquette in the SP since the 2002–2003 SARS-CoV-1 epidemic (World Health Organization, 2006). At that time, it was clearly recognized that there are benefits to covering the mouth to prevent droplet transmission: one of the main routes of transmission of COVID-19 (Rabi et al., 2020). This recommendation has since been amended to include the use of masks (World Health Organization, 2020).

Alongside physical measures to avoid infection, healthy diet and regular exercise are advocated to boost immune function, for example, by lowering chronic low-grade inflammation (Gleeson et al., 2011; Nieman & Wentz, 2019). These measures are regularly promoted in popular media and websites to the general public as having a protective effect against infections (Paul & Dredze, 2014). Many of the public have also adopted the use of gloves as a self-protection tool (European Centre for Disease Prevention and Control, 2020), although Yadav et al. (2020) reported that glove use increases the risk of cross-transmission if proper technique and precautions are not followed. Faced with such conflicting information on how best to be protected and avoid contracting COVID-19, and in view of the fact that the general public might not be fully educated on PPE use, it is important to ascertain what actions people are taking to avoid exposure to COVID-19.

In order to explore the strategies adopted by the public, we established a collaboration to consider samples from two countries, Australia and Germany. Although the profile of the pandemic in Australia and Germany has been slightly different, there are some commonalities demonstrated in their approach to guidelines provided to the public and other initiatives. The first cases of COVID-19 were reported in late January 2020 in both Germany (January 27) and Australia (January 25). Both countries quickly introduced public health messages around the need for social distancing, limited public gatherings, and work from home while emphasizing the necessity for hand hygiene. Germany quickly required travelers originating from high-risk areas (i.e., China and Italy) to provide information about possible exposure, and on March 18 Germany acted to prevent non-EU citizens from entering Germany and implemented a 14-day quarantine for anybody entering the country from April 10, regardless of country of origin (German Federal Ministry of Health, 2020). Conversely, Australia blocked arrivals from China as early as February 2, and required mandatory hotel quarantine for all international arrivals from March 28 (Karp & Murphy, 2020). Both countries also implemented contact tracing and testing strategies early in the outbreak.

The study aims were to investigate the strategies people in Australia and Germany use to protect themselves from contracting COVID-19 as well as situations they avoid to reduce their risk of contagion. These data will provide insight into the current strategies adopted by the public and provide a basis for informing future advice and determining whether pandemic fatigue occurs over time in the adoption of these strategies (MacIntyre et al., 2021). In order to determine these strategies, we wrote items targeted at avoidance and protective strategies most likely to be employed by people at this time.

Data were collected in Germany and in Australia during late April and early May, 2020, when the populations of both countries were in social lockdown, and were collated and compared to determine the strategies used by people in these two countries.

2 | METHOD

2.1 | Design

This was a cross-sectional online study of convenience samples to assess the strategies used by the public to protect themselves from, and avoid exposure to, COVID-19.

2.2 | Participants

Data were obtained as part of a larger study from participants in Australia and in Germany. Australian data were collected from 213 respondents (147 females) whose mean age was $M = 37.82$ years ($SD = 13.24$). The German sample comprised 424 respondents (320 females) whose mean age was 37.25 years ($SD = 10.88$).

2.3 | Scale development

A review of the literature identified common behaviors around infection prevention which were used as a basis to generate questions for this study. These questions focus on strategies people use to actively protect themselves and situations they avoid, in order to reduce the possibility of contracting COVID-19. Initially written in English, the questions were then submitted to a forward/backward translation following the recommendations of Beaton et al. (2000). The first step was the translation of the English version of the scales into German by an academic fluent in both languages. A second academic fluent in both German and English subsequently back translated the scales. The two professionals then discussed and evaluated any discrepancies and produced the final version of the scales in German.

2.4 | Procedure

Ethical approval was granted by Federation University Australia's Human Ethics Committee (#B20-23), following which the study was uploaded in English to Qualtrics.com, and in German to Soscisurvey.de after an extensive process of translation and back translation by two academics fluent in both German and English. Advertisements were posted on social media in English and German respectively, inviting residents to participate in an online study on the factors influencing behavior around COVID-19. The Plain Language Statement on the opening page of each survey advised readers that participation was voluntary, their data anonymous, and submission of the completed questionnaire would be deemed to be their informed consent. No incentives were offered for participation.

2.5 | Materials

The Protection from Infection Scale (PIS) has nine items (e.g., "To protect myself from coronavirus I … wash my hands; eat a balanced diet; use hand sanitizer"). Items are rated on a 5-point Likert scale from 1 = *Not at all* to 5 = *Always*.

The Infection Avoidance Scale (IAS) has 10 items (e.g., "To avoid getting coronavirus, I have not or avoid … travel to infected areas; large gatherings of people; touching my face"). Items are rated on a 5-point Likert scale from 1 = *Not at all* to 5 = *Always*.

In addition, participants were asked to provide demographic data on their age, gender, marital, and educational status.

2.6 | Analyses

Principal component analysis of the scales developed for this study was conducted on the Australian data to identify factors, and confirmatory factor analysis (CFA) conducted on the German data. Cronbach's α was used to determine scale reliabilities and an independent *t*-test, with a Bonferroni correction factor, to compare scale scores by country.

3 | RESULTS

The data were exported to SPSS for the analyses. Fifty-six percent of the 213 people in the Australian sample were married/cohabitating, 34% were single, and 10% reported they were separated or divorced. The majority of respondents were university educated (87%) or had completed high school or an apprenticeship (13%). Of the 424 German respondents, the majority were married or cohabitating with a partner (70.3%), 25.6% were single, 10% reported they were widowed, and 4% of participants failed to answer this question. The majority of German respondents (65.4%) had completed or were undertaking a university degree, 7.2% reported they held a postgraduate degree, 8.4% reported they had completed middle school, and 19% had completed or were undertaking an apprenticeship. In order to confirm the adequacy of the samples, an a priori test with a power of 0.8 and an alpha of $p < 0.05$, with N1/N2 = 1, yielded a recommended sample size of 64 in each group ([G*Power] V 3.1.9.7). Our actual Australian and German samples sizes exceeded this recommendation at 213 and 424, respectively.

The data were screened for missing data and normality. Eleven Australian and 10 German participants failed to complete the majority of items and were removed from subsequent analyses. Across the other participants there were less than 1% missing data distributed randomly and item-mean substitutions were used by country. Usable data were available from 414 German participants and 202 Australian participants.

3.1 | Principal component analysis

Principal component analysis was conducted on the PIS and the IAS using the Australian data. The Kaiser-Myer-Olkin statistic and Bartlett's test of sphericity both indicated the factorability of the data in each scale.

The PIS revealed two independent factors, labeled Self-Care and Protective Behaviors ($r = 0.09$), which together explained 42.77% of the variance. Internal reliabilities were strong (Cronbach's $\alpha = 0.79$ and 0.84, respectively; Table 1). The full scales are available in S1 and S2.

TABLE 1 Results from a factor analysis of the Protection from Infection Scale (PIS)

	Factor loading	
To protect myself from coronavirus, I ...	**1**	**2**
Factor 1: Self-care		
Exercise regularly	0.86	−0.13
Eat a balanced diet	0.81	
Make sure I get enough sleep	0.73	0.17
Factor 2: Protective behaviors		
Wear a mask when outside my house	−0.13	0.64
Wash my hands		0.62
Use hand sanitizer		0.59
Wear gloves when outside my house		0.51
Take vitamins and/or herbal supplements	0.276	0.45
Follow government advice		0.40
Mean	13.06	26.85
SD	3.13	4.59

TABLE 2 Results from a factor analysis of the Infection Avoidance Scale (IAS)

To avoid getting coronavirus, I have not or avoid ...	**Factor loading**
Factor 1: Avoidance	
Shaking hands	0.91
Travel on public transport	0.84
Eating in restaurants or cafes	0.83
Large gatherings of people	0.81
Hugging others	0.81
Travel to infected areas	0.74
Leaving home except to shop for food & essentials	0.59
Going to work or school	0.58
Touching my face	0.50
People who cough or sneeze	0.38
Mean	43.27
SD	7.72

The IAS was unifactorial, explaining 51.62% of the variance. Internal reliability was strong (Cronbach's $\alpha = 0.88$; Table 2).

3.2 | Confirmatory factor analysis (CFA)

The German data were used to conduct CFA on the two scales, PIS and IAS. Support for the structure of both scales was confirmed with these data. While the modification indices suggested intra-correlations between scale items which would improve the fit, these modifications were not adopted in order to maintain the parsimony of the scales. All items on the PIS loaded significantly onto their respective latent factors, and the two factors were again independent ($r = 0.12$). The fit of the data for the PIS was satisfactory ($\chi^2[26] = 75.21$, $p < 0.001$, c/min = 2.89, CFI = 0.89, RMSEA = 0.07, and p/close $p = 0.047$). Each item on the IAS loaded significantly onto the single factor and the fit of the data to the model was satisfactory ($\chi^2[35] = 250.91$, $p < 0.001$, c/min = 7.11, CFI = 0.90, RMSEA = 0.09, p/close = 0.05).

3.3 | Comparisons by country

Independent t-tests using a Bonferroni correction factor ($p = 0.017$ at 5% level) were used to compare the total scores on the Self-Care and Protective Behaviors factors of the PIS, and the IAS by country (Table 3). The Australian sample scored statistically higher on all three scales than the German sample. The effect sizes for unequal groups using Hedges' g were moderate to large. We then drilled down to explore differences by country on participants' ratings of individual items using a series of independent t-tests.

We used Microsoft Excel to graph the item means for each scale by country and have indicated those which were significantly different. On the PIS, there was no difference by country on the Self-Care items (i.e., eating well, exercising, and getting adequate sleep) that participants used to protect themselves from COVID-19. In terms of the Protective Behaviors factor, the Australian sample reported significantly higher scores on the use of hand sanitizer, taking vitamins, and following government advice around COVID-19, while the German participants reported using hand washing more to protect themselves and also reported wearing masks more when outside the home. There was no difference on the wearing of gloves outside the home (Figure 1).

The items on the IAS revealed no differences by country for participants avoiding using public transport, large groups, and restaurants and cafés. The German sample avoided touching their face, shaking hands, and hugging others more than the Australian sample, but the Australian sample indicated they avoided travel, leaving the house, people who sneeze or cough, and going out except for work or schooling (Figure 2).

4 | DISCUSSION

The aim in this study was to investigate the protective measures the general public use and the situations they avoid to reduce their risk of contracting COVID-19 across Australian and German samples. In order to assess these strategies, we developed domain specific measures targeting government recommendations at this time and components of PPE used by health professionals.

Principal component analysis using the Australian data revealed that the PIS yielded two independent factors: Self-care and Protective Behaviors; while the IAS was unifactorial. Internal reliability was strong for all factors. The factor structure of both scales was confirmed in the German data using CFA.

TABLE 3 Means, standard deviations, and independent *t*-test for the Protection from Infection and Infection Avoidance Scales

Measure	Australian		German				Effect size
	M	*SD*	*M*	*SD*	*t* (514)	*p*	Hedges' g
Protection from Infection							
Self-care	13.06	3.13	10.64	2.86	9.05	<0.001	0.82
Protective behaviors	26.85	4.59	18.04	3.66	24.13	<0.001	2.21
Infection Avoidance	43.27	7.72	41,19	6.49	3.30	=0.001	0.30

FIGURE 1 Comparison of item means by country for the Protection from Infection Scale (PIS). ns, not significant, *$p < 0.05$. German; Australian

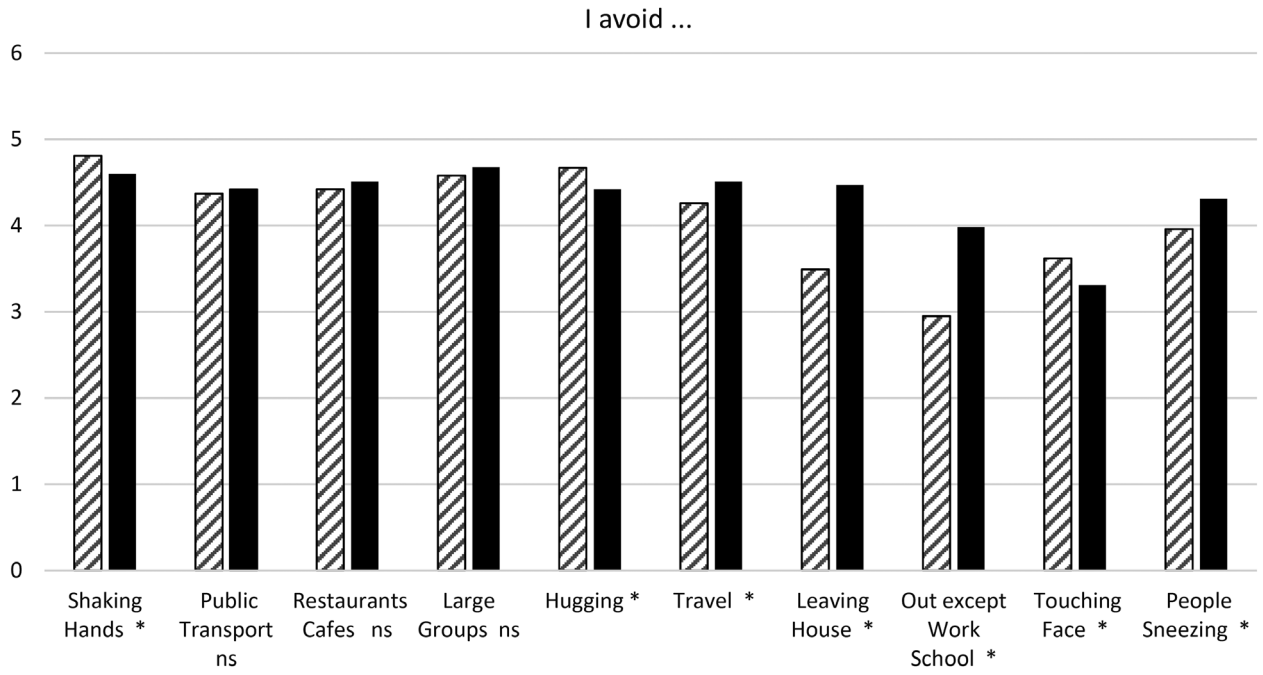

FIGURE 2 Comparison of item means by country for Infection Avoidance Scale (IAS). ns, not significant, *$p < 0.05$. German; Australian

A comparison of the Australian and German data revealed that globally the Australian participants scored higher overall on strategies to protect themselves from infection, both self-care and protective behaviors, and on infection avoidance initiatives. We drilled down to the individual items, and aside from some differences, we found several areas of commonality.

On the PIS, participants from both countries reported adopting similar levels of self-care that is, exercising regularly, eating a balanced diet, and ensuring they get enough sleep. While these behaviors might form part of people's normal routine, and do not specifically protect people from COVID-19, these self-care behaviors do contribute to overall physical well-being which is especially important during this pandemic and period of social isolation (Leigh-Hunt et al., 2017). In contrast, Mutz and Gerke (2021) found that 60% of their German sample were sedentary during COVID-19. In terms of the Protective Behaviors factor, there was no difference by country on wearing gloves outside the house although scores on this item were low overall. A low score is not unexpected as, unlike health professionals in their workplace, this was not a government mandated requirement for the general public and it has been shown to increase the risk of cross transmission when used outside of health care settings (Yadav et al., 2020). More German participants reported wearing masks outside the home than did Australians, although it is also important to note that during data collection, the use of masks became compulsory in Germany on April 22 (Mitze et al., 2020) when using public transport and while shopping. There was no such requirement in Australia at the time these data were collected. Australians scored higher on taking vitamin supplements and using hand sanitizers while German participants scored higher on hand washing. It is suggested that there is a balance between participants' hand washing and use of hand sanitizers so that both groups are equally conscious of the need for hand cleansing. It is also relevant to note that scores on hand washing were high, demonstrating close to a ceiling effect. The final item relates to following government recommendations, and while the Australian sample scored higher than the German group, both samples reported high scores. It is important to note that the magnitude of any differences was not large.

The items from the IAS revealed that both samples avoided public transport, restaurants and cafés, and large groups, typically areas of possible contagion, as recommended by governments. The German sample reported higher scores on avoiding shaking hands, hugging, and touching their face; the Australian sample scored higher on avoiding travel, avoiding leaving the house either generally or unless for work and school, as well as avoiding people who sneeze or cough. Again, the magnitude of any differences was not large.

Despite the good psychometric properties of the scales developed for this study and the apparently high level of strategies both groups reported in order to protect themselves and avoid possible infection, it must be noted that participants were recruited via social media and completed the survey online. As such there is always the possibility of selection bias. Furthermore, participants in both countries were highly educated and overrepresented by females.

5 | IMPLICATIONS

The ability of health care workers and governments to understand the general public's adoption of masks, PPE more generally, and disease avoidance strategies is essential. Monitoring this information will enable policy makers to determine any pandemic fatigue (MacIntyre et al., 2021) among the public which might lead to a decline in the use of disease avoidance strategies over time. These data can also enable government and health workers to target advice to the general public to ensure the use of disease avoidance strategies is sustained. Such advice could complement the role-modeling provided by health workers and ensure that the public continue to employ disease avoidance strategies and reduce the spread of COVID-19.

6 | CONCLUSION

In conclusion, the construct validity and internal reliability of the scales we devised for this study were satisfactory. While Australians reported higher protective and avoidance strategies than Germans overall, when examined at the micro level, there were many commonalities including the use of self-care behaviors to protect themselves from contracting COVID-19, wearing gloves although not mandated, and avoiding public places (transport, restaurants and cafés, large groups). While there were differences on several items it is important that the magnitude of these differences was small. It is particularly encouraging that people from two different continents faced with a pandemic common to both were largely adherent to the use of relevant PPE and moreover, followed their respective governments' advice around strategies to reduce the transmission of COVID-19. As there is currently no foreseeable end to this pandemic, particularly in parts of Europe, the Americas, Asia, and Africa, community efforts to reduce transmission remain imperative. It will be important to ascertain in follow-up studies whether people continue to adopt protection and avoidance strategies and follow government advice.

AUTHOR CONTRIBUTIONS

Study design: Kathleen A. Moore.
Data collection: Kathleen A. Moore, Petra Buchwald.
Data analysis: Kathleen A. Moore, Stephane Bouchoucha.
Manuscript writing: Kathleen A. Moore, Stephane Bouchoucha, Petra Buchwald.

DATA AVAILABILITY STATEMENT

Data available on request due to privacy/ethical restrictions

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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