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Correlates of intention-to-attend and confirmed cervical screening attendance during the COVID-19 pandemic in Australia: Findings from Compass-PLUS, a prospective cohort study

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ABSTRACT

Objective: The coronavirus pandemic impacted health-seeking behaviour and access to primary care in Australia. We investigated factors associated with intention-to-attend and attendance of cervical screening during the pandemic, mainly in Victoria, Australia.

Methods: We used questionnaire and attendance data (Aug 2020-Nov 2022) from Compass-PLUS, a sub-study of the Compass randomized-controlled trial of Human Papillomavirus-based vs cytology-based screening. Data was restricted to the HPV-screening arm for comparability to the national program. We investigated associations overall and for younger (25–39 years) and older (≥40 years) cohorts, between intention-to-attend/attendance, and socio-demographics, anxiety-related scores, and agreement with beliefs about screening during the pandemic (e.g. importance of screening, increased workload, working from home, risk of infection).

Results: Among 2,226 participants, positive intention to attend screening was more likely among those with a family history of cancer ($p = 0.030$) or living outside major cities ($p = 0.024$). Increased attendance was associated with increasing age ($p < 0.001$), prior regular cervical screening history [adjusted relative risk (aRR) for 2 screens in 6 years vs none: 1.23 (95 %CI 1.09,1.40); $p < 0.001$], and part-time employment or retirement compared to full-time employment [aRR:1.08 (1.02,1.14); aRR:1.12 (1.03, 1.22); respectively]. Lower attendance was related to increased agreement with statements indicating screening de-prioritisation (p-trend < 0.05) and higher recent anxiety, specifically in the older cohort (p-trend $= 0.002$).

Conclusions: Reduced priority of screening and heightened recent anxiety may partly explain indications of lower-than-expected cervical screening rates during the pandemic. It is important that catch-up of missed HPV screens is performed to prevent a possible increase in cancer diagnoses in the long term.

1. Introduction

In 2018 the World Health Organisation announced a global call to eliminate cervical cancer in the next century. The elimination strategy set targets for three pillars of cervical cancer control: Human Papilloma Virus (HPV) vaccination, cervical screening and treatment of pre-cancer and cancer lesions (WHO, 2020). Following the outbreak of the coronavirus disease (COVID-19) in 2020, disruptions to cervical screening

Abbreviations: NCSP, national cervical screening program; AMD, adjusted mean differences; aRR, adjusted relative risk.

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services were reported in many countries (Sasidharanpillai and Ravishankar, 2022). These are predicted to lead to cancers being diagnosed at a later stage, delayed treatment of cervical disease and an increase in cervical cancer cases (Nickson et al., 2023).

In Australia, the renewed National Cervical Screening Program (NCSP), has offered 5-yearly primary HPV-based screening among women 25–74 years since December 2017 (2-yearly cytology previously). During the pandemic the NCSP continued to operate. A reduction in cervical screens in Australia was expected in 2020 from the transition to 5-yearly screening (Smith et al., 2016) complicating the interpretation of changes in the number of tests in 2020 compared to 2019. Nevertheless, there is evidence of fewer cervical tests performed in 2020 compared to those expected in the third year of the program; 64.5 % of eligible women (aged 25–69) in Victoria were up to date with screening compared to an expected 71 % (ACPCC, 2022). Apart from the direct effects of the pandemic on cervical screening programs (Sasidharanpillai and Ravishankar, 2022), there has been little research on indirect effects, such as factors affecting women's intentions to attend screening during that period, and whether these are related to attendance. Identifying these factors can help characterize screening behaviours and provide insights for improving future screening participation. Non-participation in cervical screening pre-pandemic, was a predictor of low intention-to-screen during the pandemic in the UK (Wilson et al., 2021), though a similar association was not found with attendance in Canada (Baaske et al., 2022).

To inform the implementation of the HPV-based screening program in Australia, a randomized-controlled trial was set-up of 2.5-year liquid based cytology (LBC) screening with reflex HPV triage testing for low-grade smears (Arm A-3 screening rounds: baseline, 2.5, 5 years) versus 5-year HPV screening with partial genotyping for HPV16/18 (Arm B-2 rounds: baseline, 5 years), known as Compass (details in appendix) (Canfell et al., 2018). The trial was a sentinel experience to the renewed NCSP, designed to model how the program may operate. A trial sub-study, Compass-PLUS, was established to measure the impact of primary HPV screening on anxiety in women with different HPV and cytology results as its primary objective to be evaluated after trial completion. This paper presents secondary objectives of Compass-PLUS. Specifically, we investigated associations between i) intention-to-attend cervical screening, and ii) confirmed screening attendance, with socio-demographic characteristics, anxiety scores and other factors, mainly from the state of Victoria, in Australia, where cervical screening continued during the pandemic.

2. Methods

2.1. Participants and recruitment

Compass-PLUS is a questionnaire-based, prospective cohort study recruiting participants from both trial arms. Pilot phase recruitment occurred August'19-March'20, followed by the main recruitment phase from August'20 onwards for which questions to investigate COVID-19-related effects on cervical screening were included. The trial recruited women from Victoria, 2015–2017, and nationally in 2018-2019. Women attended a baseline screen upon trial entry and date of birth, postcode of residence and contact details were collected. Subsequent trial screens were determined according to the screen result and trial arm (Supplementary Figure 1).

In the main recruitment phase of Compass-PLUS, women were invited to participate before attending their exit HPV screen (last screen within trial). Invitations for screening were sent 3-months prior to the screen due date, as is usual practice within the NCSP. Two weeks after letters were sent, trial participants received an email invitation to Compass-PLUS with an online link to study information and a consent process leading to an online questionnaire. Reminder emails were sent after 3 and 5-weeks.

The current analyses were restricted to the HPV-screening arm to reflect the current NCSP. Screening attendance invistigated in this study refers to Compass-PLUS participants attending their exit trial screen. The cut-off for attending the exit screen was 6-months from the time of screen invitation (3 months after screen due date).

The Compass trial has received ethics approval from Bellberry Human Research Ethics Committee (HREC) (reference ID: 2014–11-592). Compass-PLUS is registered as a sub-study of the trial with Bellberry HREC and is covered by the same ethics approval.

2.2. Characteristics and measures assessed

Questionnaire data were collected from August'20 until 15th June'22 and attendance data until 6th November'22 (Fig. 1). Questionnaire-derived variables included employment, education, country of birth and family history of cancer. Variables from the Compass Trial Register were date of birth (for age at questionnaire completion), HPV status at trial entry, state/territory and postcode of residence which was used to determine remoteness of residence and socio-economic status (SES) for areas, ranked according to relative socio-economic advantage and disadvantage (ABS, 2016). Screening history prior to trial recruitment refers to cytology data (2-yearly screening) from linked Registry data measured over two periods: (i) 1–3.5 years and (ii) 3.5–6 years.

Supplementary Table 1 presents all measures evaluated. Three anxiety-related scores were measured, based on a modified version of a validated tool (Riba et al, 2019): an overall pandemic anxiety score based on the question "Thinking about the COVID-19 pandemic, please select the number (1–10) that best describes how much distress/anxiety you have experienced in general since the outbreak due to COVID-19), a recent anxiety score ("Please select the number (1–10) that best describes how much distress/anxiety you have experienced in the past week including today") and a COVID-19 influence score ("On a scale of 1–10, how influential will the COVID-19 outbreak be on your decision to attend your next cervical screening test?"). Measures were analysed continuously when treated as dependent variables, and both continuously and categorically when treated as independent variables, with categorical version grouped into: low (scores 1–3), moderate (scores 4–7), and high (scores 8–10)]. Beliefs about screening during the pandemic and perceived vulnerability to disease (eight and seven statements, respectively), forming part of a validated subscale of the Perceived Vulnerability to Disease tool (Duncan et al., 2009), were assessed. Responses were analysed continuously and categorically as independent variables with categorical versions grouped as strongly disagree/disagree; neutral; strongly agree/agree. From responses to the statements in the Perceived Vulnerability to Disease tool, the "perceived infectability index" was also assessed, calculated as the mean of the seven responses after reversing the scale for three items to "strongly agree"=1 to "strongly disagree"=5.

2.3. Statistical methods

Continuous and dichotomous dependent variables were summarized as means and percentages, respectively. Linear regression was used to estimate the associations between continuous dependent variables and independent variables with mean differences as the measure-of-effect. Poisson regression with robust variance was used to estimate the associations between dichotomous variables and various independent variables with relative risks (RRs) as the measure-of-effect (Zou 2004). Independent variables included in the regression models were selected a priori and listed below the tables. Wald tests for trend were performed by replacing categorical versions of independent variables with their continuous counterparts in the regression models (p values denoted as "p-trend").

Analyses were conducted for the cohort and for age strata [25–39 at trial recruitment (born at/after the 1st July'80; vaccine eligible); ≥40 years old at recruitment (born < 1st July'80, HPV vaccine ineligible)]

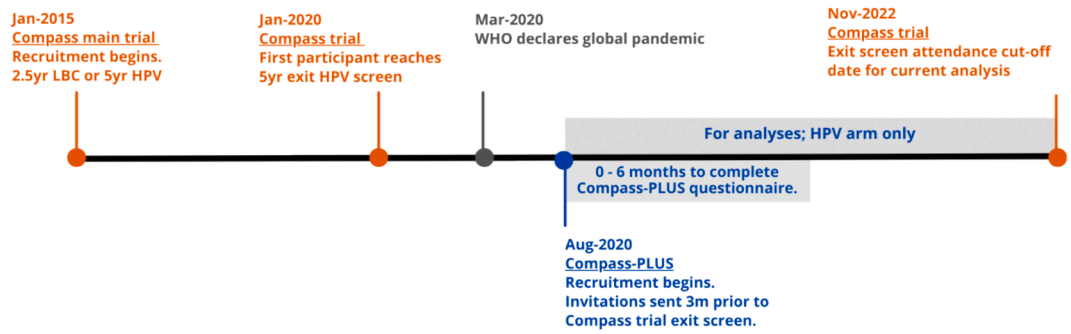

Fig. 1. Diagram showing timelines for the Compass trial (recruitment 2015–2019) and Compass-PLUS study (main study recruitment from 2020 and currently ongoing) and data collection cut-offs. (Both studies were conducted in Australia). LBC: liquid-based cytology; yr: year.

using interaction terms between 'cohort' and each independent variable assessed in analyses; these are referred to as the 'older cohort' and 'younger cohort'. Analyses couldn't be conducted by vaccination status; collection of this data is currently underway through linkage with the Australian Immunisation Register.

For visualizing trends in intended and attendance rates, overall pandemic score, recent anxiety score, and the COVID-19 score, locally weighted scatterplot smoothing (LOWESS) plots were generated with a bandwidth of 0.6 (Cox 2005). Data for the plots were restricted to Melbourne participants. Agreement between intention and attendance of exit screen was assessed using Cohen's kappa statistic (Landis and Koch, 1977). All statistical tests were conducted with Stata 18 (StataCorp., 2023) using a two-sided approach at a 0.05 significance level.

3. Results

3.1. Included participants

3,015 Compass-PLUS participants in the HPV-screening arm provided data (questionnaire and screening attendance) by the 6th November'22 (~20 % of invited trial participants consented to Compass-PLUS). 789 participants were excluded; reasons included screening before study invitation or questionnaire completion (n = 278), screened 12 months before the exit screen (n = 309), and screening allowance window (6 months) not yet reached (n = 202). Data from the remaining 2,226 participants were included, 56 % (n = 1,246) from the older and 44 % (n = 980) from the younger cohorts.

Most Compass-PLUS participants were < 50 years (62 %), employed (79 %), tertiary educated (85 %), lived in a major city (63 %), or in higher SES areas (quintile 4–5: 64 %) and had a family history of cancer (68 %) (Table 1). Almost all participants (97 %, 2160/2226) reported being likely to attend their next screen (due in ≤ 3 months) but attendance within 6 months of their screen invitation was lower (73 %; Supplementary Table 2). Overall, there was very low agreement between intention-to-attend and attendance (kappa = 0.06).

3.2. Socio-demographic/health characteristics and anxiety scores

Associations between socio-demographic/health characteristics and adjusted mean anxiety scores are presented in Table 1. Overall pandemic anxiety was moderate, with a mean of 5.51 out of 10 (SD 2.31). Scores were lower for participants living outside major cities ($p < 0.001$) and decreased with increasing age ($p < 0.001$). Recent anxiety was somewhat lower (mean = 4.39; SD=2.43) but there were similar associations with age ($p < 0.001$) and living outside major cities ($p = 0.002$). Additionally, recent anxiety scores varied by employment status ($p = 0.016$); compared to fully-employed participants, scores were lower in retired participants [adjusted mean difference (AMD): −0.57 (95 %CI: −1.04, −0.11)] but higher in full-time carers [AMD: 0.61 (95 %CI: 0.03, 1.18)].

The COVID-19 influence score was low (mean of 2.33 (SD=2.30)) and not related to any socio-demographic/health characteristics (Table 1). However, this score was significantly associated with country of birth in younger ($p = 0.03$) and older cohorts ($p = 0.04$) and the difference between these cohorts was significant [p-value for interaction = 0.016]. In the older cohort, those born in Asia had higher scores compared to those born in Australia [AMD: 1.35 (95 %CI 0.38, 2.32)]. In the younger cohort, participants born in the UK/Ireland and New Zealand had lower scores compared to Australian-born participants [AMD UK/Ireland: −0.77 (95 %CI: −1.47, −0.06); New Zealand: −0.88 (−1.75,-0.01)].

3.3. Anxiety scores and intention-to-attend or attendance

Intention-to-attend and attendance weren't associated with any anxiety scores in the overall group (Supplementary Tables 3,4). There was, however, a difference between age cohorts related to recent anxiety scores and attendance (p-value for interaction = 0.024). In the older cohort, those with higher scores were less likely to attend their exit than those with low scores ($p = 0.006$, Supplementary Table 5). Those with moderate scores in the older cohort were less likely to attend [RR=0.97 (95 %CI 0.94, 0.99)], but the direction of this effect was reversed in the younger cohort [RR=1.12 (95 %CI: 1.00, 1.25)] (data not shown).

3.4. Socio-demographic/health and intention-to-attend or attendance

Intention-to-attend screening was somewhat more likely in participants with family history of cancer versus those without [Adjusted RR (aRR) family history vs without: 1.02 (95 %CI 1.00,1.04), $p = 0.030$)] and those living outside major cities [aRR outer regional/remote/very remote vs major cities: 1.04 (1.01,1.06); $p = 0.024$)] (Supplementary Table 6).

Attendance was more likely with increasing age ($p < 0.001$), and related to employment status ($p = 0.033$); part-timers and retirees were more likely to attend their screen than full-timers, [(aRR) part-timers vs full-timers: 1.08 (95 %CI 1.02, 1.14); aRR retirees vs full-timers: 1.12 (95 %CI 1.03, 1.22)] (Table 2). Additionally, attendance was associated with screening history ($p < 0.001$); participants who attended two screens within 6 years prior to trial entry were more likely to attend screening during the pandemic compared to those with no screens [aRR for '2/2'vs '0/2': 1.23 (95 %CI 1.09, 1.40)] (Table 3). No association was found between HPV status and intention-to-attend, nor attendance.

3.5. Intention-to-attend or attendance and beliefs about screening during the pandemic

An increased likelihood of screening was strongly associated with increased agreement to the statement 'inclined to attend test as it is important to my health not to delay it' ($p < 0.001$) (Table 3). Conversely, a decreased likelihood of screening was strongly related to

Table 1
Associations between socio-demographic/health and testing characteristics and overall pandemic anxiety, recent anxiety and COVID-19 influence scores among participants within the HPV-screening cohort of Compass-PLUS, a study conducted Aug'2020 to Nov'2022 in Australia (n = 2226).

Participant characteristics	n (%)	Overall pandemic anxiety score[1]		Recent anxiety score[2]		COVID-19 influence score[3]	
		Mean	AMD (95 % CI)^	Mean	AMD (95 % CI)^	Mean	AMD (95 % CI)^
Total:	2226 (100)	5.51		4.39		2.33	
Age (years)							
26–39	912 (41)	5.93	ref.	4.87	ref.	2.31	ref.
40–49	476 (21)	5.75	−0.13 (−0.38, 0.13)	4.40	−0.38 (−0.65, −0.11)	2.61	0.31 (0.05, 0.57)
50–59	390 (18)	5.29	−0.51 (−0.79, −0.22)	4.35	−0.37 (−0.67, −0.08)	2.32	0.12 (−0.18, 0.41)
60–69	373 (17)	4.69	−0.98 (−1.33, −0.63)	3.64	−0.85 (−1.21, −0.48)	2.14	0.04 (−0.32, 0.39)
70–75	75 (3)	3.79	−1.68 (−2.38, −0.98)	2.46	−1.68 (−2.41, −0.96)	1.73	−0.22 (−0.92, 0.48)
p-value			<0.001		<0.001		0.182
Employment status							
Full-time or self-employed	1027 (46)	5.62	ref.	4.56	ref.	2.36	ref.
Part-time	732 (33)	5.67	0.10 (−0.11, 0.32)	4.44	−0.08 (−0.30, 0.15)	2.39	0.08 (−0.14, 0.30)
Full-time carer	70 (3)	5.93	0.14 (−0.41, 0.69)	5.33	0.61 (0.03, 1.18)	2.34	0.05 (−0.53, 0.62)
Student	37 (2)	5.86	0.12 (−0.64, 0.88)	4.72	0.08 (−0.70, 0.87)	2.06	−0.39 (−1.16, 0.37)
Unemployed	92 (4)	5.62	0.15 (−0.34, 0.63)	4.87	0.48 (−0.04, 1.00)	2.53	0.20 (−0.30, 0.71)
Retired	252 (11)	4.34	−0.27 (−0.71, 0.18)	3.13	−0.57 (−1.04, −0.11)	1.91	−0.20 (−0.65, 0.25)
Prefer not to say	16 (1)	5.60	0.23 (−0.92, 1.39)	4.00	−0.22 (−1.43, 1.00)	2.86	0.55 (−0.68, 1.77)
p-value			0.745		0.016		0.670
Highest education level							
School	318 (14)	5.24	ref.	4.11	ref.	2.26	ref.
Certificate/trade/diploma	470 (21)	5.44	−0.01 (−0.34, 0.32)	4.47	0.19 (−0.15, 0.54)	2.23	−0.09 (−0.42, 0.25)
Bachelor degree	798 (36)	5.60	−0.01 (−0.31, 0.30)	4.53	0.14 (−0.18, 0.47)	2.36	−0.07 (−0.39, 0.24)
Postgraduate degree	630 (28)	5.60	−0.09 (−0.42, 0.23)	4.32	−0.14 (−0.48, 0.20)	2.41	−0.11 (−0.44, 0.23)
Prefer not to say	10 (0)	4.00	−0.81 (−2.24, 0.63)	2.80	−0.80 (−2.30, 0.71)	1.30	−0.85 (−2.32, 0.61)
p-value			0.771		0.091		0.817
Family history of cancer							
No/unsure	710 (32)	5.49	ref.	4.32	ref.	2.34	ref.
Yes	1516 (68)	5.51	0.04 (−0.17, 0.24)	4.43	0.11 (−0.11, 0.32)	2.32	0.01 (−0.20, 0.21)
p-value			0.724		0.324		0.955
State/territory of residence							
Victoria	2132 (96)	5.53	ref.	4.40	ref.	2.35	ref.
New South Wales	52 (2)	5.21	−0.18 (−0.84, 0.48)	4.34	−0.02 (−0.70, 0.66)	1.78	−0.39 (−1.05, 0.28)
Queensland	15 (1)	4.87	−0.73 (−1.88, 0.43)	3.27	−1.33 (−2.53, −0.12)	1.60	−0.77 (−1.95, 0.41)
Other states/territories	27 (1)	5.00	−0.54 (−1.43, 0.36)	4.12	−0.14 (−1.06, 0.78)	2.08	−0.23 (−1.13, 0.67)
p-value			0.375		0.195		0.376
SES of residence area							
1 − Lowest SES	155 (7)	5.49	ref.	4.39	ref.	1.98	ref.
2	305 (14)	5.39	−0.21 (−0.66, 0.23)	4.37	−0.12 (−0.59, 0.34)	2.05	0.04 (−0.41, 0.50)
3	339 (15)	5.30	−0.39 (−0.83, 0.05)	4.27	−0.27 (−0.73, 0.19)	2.05	0.01 (−0.44, 0.46)
4	572 (26)	5.56	−0.27 (−0.70, 0.16)	4.59	−0.07 (−0.52, 0.37)	2.41	0.28 (−0.16, 0.71)
5 − Highest SES	855 (38)	5.59	−0.37 (−0.81, 0.07)	4.31	−0.42 (−0.87, 0.04)	2.54	0.33 (−0.12, 0.78)
p-value			0.430		0.092		0.259
Remoteness of residence							
Major Cities	1400 (63)	5.73	ref.	4.54	ref.	2.50	ref.
Inner Regional	732 (33)	5.13	−0.57 (−0.82, −0.32)	4.19	−0.40 (−0.66, −0.14)	2.04	−0.27 (−0.53, −0.02)
Outer Regional/very Remote	94 (4)	5.10	−0.59 (−1.11, −0.08)	3.84	−0.79 (−1.33, −0.25)	1.92	−0.31 (−0.84, 0.21)
p-value			<0.001		0.002		0.095
Country of birth							
Australia	1848 (83)	5.52	ref.	4.43	ref.	2.29	
UK/Ireland	131 (6)	5.04	−0.34 (−0.74, 0.07)	3.91	−0.35 (−0.78, 0.07)	2.31	0.01 (−0.41, 0.42)
Asia	60 (3)	5.14	−0.73 (−1.32, −0.13)	3.95	−0.73 (−1.35, −0.12)	3.37	0.87 (0.28, 1.47)
New Zealand	52 (2)	5.79	0.04 (−0.58, 0.67)	4.65	−0.03 (−0.69, 0.63)	2.13	−0.29 (−0.93, 0.35)
Other/unknown	135 (6)	5.82	0.17 (−0.24, 0.57)	4.40	−0.14 (−0.56, 0.29)	2.48	0.09 (−0.33, 0.50)
p-value			0.054		0.099		0.055
Screen attendance prior to recruitment to Compass trial^^							
0/2	200 (9)	5.93	ref.	4.82	ref.	2.45	ref.
1/2	466 (21)	5.74	−0.20 (−0.58, 0.18)	4.64	−0.19 (−0.59, 0.21)	2.48	−0.04 (−0.43, 0.35)
2/2	1560 (70)	5.38	−0.29 (−0.64, 0.06)	4.26	−0.29 (−0.66, 0.07)	2.27	−0.22 (−0.58, 0.13)
p-value			0.242		0.264		0.221

(*continued on next page*)

Table 1 (*continued*)

Participant characteristics	n (%)	Overall pandemic anxiety score[1]		Recent anxiety score[2]		COVID-19 influence score[3]	
		Mean	AMD (95 % CI)^	Mean	AMD (95 % CI)^	Mean	AMD (95 % CI)^
Baseline HPV test result							
No HRHPV detected *	2170 (97)	5.51	ref.	4.39	ref.	2.34	ref.
HRHPV detected	56 (3)	5.31	−0.26 (−0.86, 0.35)	4.38	−0.06 (−0.69, 0.58)	1.87	−0.48 (−1.10, 0.14)
p-value			0.406		0.862		0.132

AMD: adjusted mean difference; HRHPV: high risk (oncogenic HPV).

^Mean differences adjusted for age, employment status, highest education level, school, family history of cancer, state/territory of residence, SES of residence area, remoteness of residence, country of birth, screen attendance prior to recruitment to Compass trial and baseline HPV test result.;[1] Overall pandemic anxiety score measured on a 10-point scale from question 13 "Thinking about the COVID-19 pandemic, please select the number (1–10) that best describes how much distress/anxiety you have experienced in general since the outbreak due to COVID-19?" with higher scores indicating more anxiety; [2] Recent anxiety score measured on a 10-point scale from question 12 "Please select the number (1–10) that best describes how much distress/anxiety you have experienced in the past week including today" with higher scores indicating more anxiety; [3] COVID-19 influence score measured on a 10-point scale from question 13 "On a scale of 1–10, how influential will the COVID-19 outbreak be on your decision to attend your next cervical screening test?" with higher scores indicating more influence.^^Screen attendance is measured over two periods from 1 to 3.5 years and from 3.5 to 6 years before recruitment to Compass. * One participant classified as "No HRHPV detected" had an unsatisfactory test result.

the statements: 'cervical screening is less of a priority during COVID-19 outbreak' (p-trend < 0.001), 'less time to think about cervical screening due to the COVID-19 outbreak' ($p = 0.035$) and 'more inclined to attend test because working from home/have more time' ($p = 0.030$). Similar associations were observed for intention-to-attend screening (Supplementary Table 7).

3.6. Perceived vulnerability to disease and intention-to-attend or attendance

No strong associations were observed for these measures (Supplementary Tables 8,9).

3.7. Intention-to-attend and attendance over time

Intention-to-attend and screening attendance rates, and mean scores among participants living in Melbourne against lockdown periods (shaded grey) are shown in Figs. 2 and 3 for the older cohort ($n = 704$) and younger cohort ($n = 659$), respectively. Despite a high intention-to-attend screening rate in the older cohort (≥90 %), the attendance rate decreased from > 90 % to just above 60 %. The COVID influence score, and to a lesser degree the overall pandemic score, also decreased. The recent anxiety score initially decreased through to December'20, then steadily increased returning to the same level as at the start.

For the younger cohort, despite a high intention-to-attend screening, attendance rates among those surveyed in August'20 were just above 50 %. Following an increase in attendance to ≥ 60 % among those surveyed from October'20 onwards, rates remained steady through 2021, returning to initial levels by June'22. The COVID influence score decreased throughout the study. Recent anxiety scores initially decreased (to February'21), then gradually increased and stabilized from September'21. The overall pandemic anxiety score fluctuated around a value of 6 throughout.

4. Discussion

In this study, we used a range of measures to investigate factors associated with intention-to-attend and confirmed cervical screening attendance among HPV-screened Compass-PLUS participants during a two-year period. Intention-to-attend was somewhat more likely when having a family history of cancer and living outside major cities, but actual attendance was predicted by older age, part-time employment or retirement, and regular cervical screening history. Neither intention-to-attend, nor screening attendance, were associated with the overall pandemic anxiety score or COVID-19 influence score in the whole cohort. However, participants in the older cohort with higher recent anxiety scores (within a week of questioning) were less likely to attend than those with lower scores. Another factor likely to have reduced attendance was de-prioritisation of cervical screening during the pandemic. Screening attendance rates differed between the older and younger cohort among the sub-group of participants living in Melbourne, which was heavily impacted by lockdowns. In the earlier pandemic period the relatively higher screening rate decreased in the older cohort but in the younger cohort, the relatively lower screening rate increased. Thereafter, rates stabilized in both cohorts before decreasing from the end of 2021 onwards, but rates remained higher in the older cohort than in the younger cohort throughout.

Limited evidence on factors associated with cervical screening attendance and intention-to-attend during the pandemic has been documented in the literature. Neither socio-demographic factors, nor history of cervical cancer, were associated with self-reported cervical screening attendance in a Canadian study conducted from August'20 to March'21 (Baaske et al., 2022). Self-reported non-participation in cervical screening prior to the pandemic was the strongest predictor of low screening intention during the pandemic based on UK data collected August-November'20. (Wilson et al., 2021). Similarly, in our study, those not screened within 6 years of trial recruitment were less likely to attend than those with 2 screens. Women who under-screened before the trial are likely to have experienced barriers to cervical screening even before the pandemic. It is possible these barriers worsened or were compounded during the pandemic due to factors such as social distancing, reduced availability of general practitioner (GP) appointments and other factors.

Interestingly, there was no indication of a substantial association between HPV status at trial entry and exit screen attendance, although this was based on a limited sample size. 42 out of 56 (75 %) participants with oncogenic HPV detected at entry had confirmed screen attendance at trial exit (vs 72 % without HPV detected). This may be partly explained by the NCSP risk-based approach whereby women at high risk (HPV16/18 positive; non-16/18 HPV positive with high-grade abnormalities) are referred to colposcopy and women at intermediate risk (non-16/18 HPV positive and LBC negative or with low-grade cervical abnormalities) undergo repeated HPV and LBC testing (Supplementary Fig. 1). These stratified screening pathways for high/intermediate risk women are likely to result in some screens becoming out of sync with the exit screen invitation. Indeed, 309 Compass-PLUS participants (of which 113 were oncogenic HPV positive) were excluded for having a screen in the 12 months before their exit screen.

We found that higher recent anxiety and reduced priority of screening (suggesting lower importance placed by participants in screening) were factors related to lower cervical screening attendance during the pandemic. However, pre-pandemic, lower perceived importance of cervical screening, often due to the lack of knowledge/awareness of screening, and psychological factors, including fear of the test

Table 2
Associations between socio-demographic/health and testing characteristics and confirmed attendance among participants within the HPV-screening cohort of Compass-PLUS (n = 2226), a study conducted Aug'2020 to Nov'2022, in Australia.

Participant characteristics	Attended screen # n/N (%)	Unadjusted RR for attended screen (95 % CI)	Adjusted RR for attended screen (95 % CI)^
Total:	1610/2226 (72)		
Age (years)			
26–39	565/912 (62)	ref.	ref.
40–49	355/476 (75)	1.20 (1.12, 1.30)	1.16 (1.08, 1.25)
50–59	308/390 (79)	1.27 (1.19, 1.37)	1.24 (1.15, 1.33)
60–69	321/373 (86)	1.39 (1.30, 1.48)	1.28 (1.18, 1.39)
70–75	61/75 (81)	1.31 (1.16, 1.48)	1.14 (0.99, 1.31)
p-value		<0.001	<0.001
Employment status			
Full-time or self-employed	700/1027 (68)	ref.	ref
Part-time	549/732 (75)	1.10 (1.04, 1.17)	1.08 (1.02, 1.14)
Full-time carer	44/70 (63)	0.92 (0.77, 1.11)	0.96 (0.80, 1.17)
Student	22/37 (59)	0.87 (0.67, 1.14)	0.93 (0.71, 1.22)
Unemployed	60/92 (65)	0.96 (0.82, 1.12)	0.94 (0.81, 1.09)
Retired	221/252 (88)	1.29 (1.21, 1.37)	1.12 (1.03, 1.22)
Prefer not to say	14/16 (88)	1.28 (1.06, 1.55)	1.14 (0.93, 1.42)
p-value		<0.001	0.033
Highest education level			
School	239/318 (75)	ref.	
Certificate/trade/diploma	333/470 (71)	0.94 (0.87, 1.03)	0.99 (0.91, 1.08)
Bachelor degree	588/798 (74)	0.98 (0.91, 1.06)	1.07 (0.99, 1.15)
Postgraduate degree	441/630 (70)	0.93 (0.86, 1.01)	1.03 (0.94, 1.12)
Prefer not to say	9/10 (90)	1.20 (0.96, 1.49)	1.18 (0.92, 1.50)
p-value		0.077	0.158
Family history of cancer			
No/unsure	506/710 (71)	ref.	
Yes	1104/1516 (73)	1.02 (0.97, 1.08)	1.03 (0.97, 1.08)
p-value		0.449	0.360
State/territory of residence			
Victoria	1545/2132 (72)	ref.	
New South Wales	37/52 (71)	0.98 (0.82, 1.17)	1.05 (0.88, 1.25)
Queensland	10/15 (67)	0.92 (0.64, 1.32)	0.99 (0.67, 1.46)
Other states and territories	18/27 (67)	0.92 (0.70, 1.20)	0.96 (0.73, 1.26)
p-value		0.894	0.942
SES of residence area			
1 – Lowest SES	112/155 (72)	ref.	
2	216/305 (71)	0.98 (0.87, 1.11)	0.98 (0.87, 1.11)
3	250/339 (74)	1.02 (0.91, 1.15)	1.03 (0.92, 1.16)
4	416/572 (73)	1.01 (0.90, 1.12)	1.02 (0.91, 1.14)
5 – Highest SES	616/855 (72)	1.00 (0.90, 1.11)	0.98 (0.88, 1.11)
p-value		0.943	0.721
Remoteness of residence			
Major Cities	1006/1400 (72)	ref.	
Inner Regional	531/732 (73)	1.01 (0.96, 1.07)	0.96 (0.90, 1.03)
Outer Regional/Remote/Very Remote	73/94 (78)	1.08 (0.96, 1.21)	1.04 (0.92, 1.17)
p-value		0.403	0.256
Country of birth			
Australia	1339/1848 (72)	ref.	ref.
UK/Ireland	94/131 (72)	0.99 (0.89, 1.11)	0.97 (0.87, 1.08)
Asia	39/60 (65)	0.90 (0.74, 1.08)	0.96 (0.80, 1.15)
New Zealand	39/52 (75)	1.04 (0.88, 1.21)	1.08 (0.91, 1.27)
Other/unknown	99/135 (73)	1.01 (0.91, 1.12)	1.06 (0.96, 1.18)
p-value		0.813	0.628
Screen attendance prior to recruitment to Compass trial^^			
0/2	116/200 (58)	ref.	ref.
1/2	284/466 (61)	1.05 (0.91, 1.21)	1.02 (0.89, 1.17)
2/2	1210/1560 (78)	1.34 (1.18, 1.51)	1.23 (1.09, 1.40)
p-value		<0.001	<0.001
Baseline HPV test result			
No HRHPV detected *	1568/2170 (72)	ref.	ref.
HRHPV detected	42/56 (75)	1.04 (0.89, 1.21)	1.04 (0.89, 1.22)
p-value		0.634	0.586

Attended screen test assessed using Compass trial data.
HRHPV: high risk (oncogenic) HPV.
^Relative risks (RRs) adjusted for age, employment status, highest education level, school, family history of cancer, state/territory of residence, SES of residence area, remoteness of residence, country of birth, screen attendance prior to recruitment to Compass trial and baseline HPV test result.
Note: RRs not adjusted for overall pandemic anxiety, recent anxiety, COVID-19 influence scores or the items derived from Q14 or Q19 since these factors are likely mediators of the effects of participant demographic/testing characteristics.
* One participant classified as "No HRHPV detected" had an unsatisfactory test result.

causing pain, were barriers to cervical screening participation (Nagendiram et al., 2020). These factors appear to remain relevant both before and during the pandemic.

Employment status was associated with attendance. This finding is in line with qualitative evidence from a survey of young Australian people during 2020 (Bittleston et al., 2022). The pandemic brought changes in employment such as working from home, increased caregiving responsibilities, and a negative effect on work-life balance, predominantly in women (McBride et al., 2021, Adisa et al., 2021). Younger people were more affected by job losses or changes in hours worked as they more frequently worked in industries affected by lockdowns (Parliament of Australia, 2023). Collectively, these changes would negatively impact time/access to preventive healthcare.

Cervical screening attendance among participants within the older cohort decreased and did not recover, nor stabilize following the last Melbourne lockdown (27th October'21) through to the end of the study period. We also found that higher recent anxiety scores among the older cohort were associated with reduced attendance compared to those with lower scores. Overall, these observations suggest older participants were more fearful of being infected than younger participants. Indeed, increasing age has been associated with worse COVID-19 disease outcomes (CDC, 2023).

Screening participation among the younger cohort at the start of the study was lower (~50 %), which is in accordance with national figures for 2018–2020 (AIHW Monitoring, 2021). Interestingly, attendance rates for this group increased to ≥ 60 % for over a year despite the mean recent anxiety score tracking along comparable levels to those observed in the older cohort. Also, we found no significant association between this score and attendance among younger women. Taken together, findings suggest that despite younger women experiencing recent anxiety, this did not negatively impact their screening and other factors

Table 3
Associations between participants' beliefs and attitudes about screening during the pandemic and attendance in the HPV-screening cohort of Compass-PLUS (n = 2226), a study conducted Aug'2020 to Nov'2022 in Australia.

Participant characteristics	Attended screen #n/N (%)	Unadjusted RR for attended screen (95 % CI)	Adjusted RR for attended screen (95 % CI)ˆ
Total:	1610/2226 (72)		
Attending test increases my risk of catching COVID-19 (a)			
Strongly disagree/ disagree	1133/1556 (73)	ref.	ref.
Neutral	242/328 (74)	1.01 (0.94, 1.09)	1.02 (0.95, 1.09)
Strongly agree/ agree	160/236 (68)	0.93 (0.85, 1.02)	0.96 (0.87, 1.05)
Unknown	75/106 (71)	0.97 (0.86, 1.10)	0.96 (0.85, 1.09)
*p-value**		0.273	0.568
*p-trend**		0.357	0.751
Attending test burdens busy healthcare workers (b)			
Strongly disagree/ disagree	1052/1421 (74)	ref.	ref.
Neutral	276/391 (71)	0.95 (0.89, 1.02)	0.95 (0.89, 1.02)
Strongly agree/ agree	219/330 (66)	0.90 (0.83, 0.97)	0.92 (0.85, 1.00)
Unknown	63/84 (75)	1.01 (0.89, 1.15)	0.97 (0.86, 1.11)
*p-value**		0.023	0.076
*p-trend**		0.024	0.050
Attending test might violate social distancing rules (c)			
Strongly disagree/ disagree	1304/1791 (73)	ref.	ref.
Neutral	150/202 (74)	1.02 (0.94, 1.11)	1.00 (0.92, 1.09)
Strongly agree/ agree	90/139 (65)	0.89 (0.78, 1.01)	0.88 (0.78, 1.00)
Unknown	66/94 (70)	0.96 (0.84, 1.10)	0.95 (0.84, 1.08)
*p-value**		0.159	0.145
*p-trend**		0.223	0.066
Cervical screening less of a priority during COVID-19 outbreak (d)			
Strongly disagree/ disagree	1212/1604 (76)	ref.	ref.
Neutral	171/256 (67)	0.88 (0.81, 0.97)	0.90 (0.83, 0.99)
Strongly agree/ agree	163/279 (58)	0.77 (0.70, 0.86)	0.80 (0.72, 0.88)
Unknown	64/87 (74)	0.97 (0.86, 1.11)	0.96 (0.85, 1.09)
*p-value**		<0.001	<0.001
*p-trend**		<0.001	<0.001
Less time to think about cervical screening due to COVID-19 outbreak (e)			
Strongly disagree/ disagree	1156/1554 (74)	ref.	ref.
Neutral	195/287 (68)	0.91 (0.84, 0.99)	0.94 (0.86, 1.02)
Strongly agree/ agree	198/300 (66)	0.89 (0.81, 0.97)	0.94 (0.86, 1.02)
Unknown	61/85 (72)	0.96 (0.84, 1.11)	0.95 (0.83, 1.09)
*p-value**		0.005	0.116
*p-trend**		<0.001	0.035
Difficult to attend test because of increased workload (f)			
Strongly disagree/ disagree	1114/1495 (75)	ref.	ref.
Neutral	171/247 (69)	0.93 (0.85, 1.01)	0.97 (0.89, 1.05)
Strongly agree/ agree	256/392 (65)	0.88 (0.81, 0.95)	0.94 (0.87, 1.02)
Unknown	69/92 (75)	1.01 (0.89, 1.14)	1.01 (0.90, 1.13)
*p-value**		0.002	0.296
*p-trend**		<0.001	0.127
More inclined to attend test because working from home/ have more time (g)			
Strongly disagree/ disagree	765/1036 (74)	ref.	ref.
Neutral	504/682 (74)	1.00 (0.94, 1.06)	1.00 (0.94, 1.06)
Strongly agree/ agree	266/407 (65)	0.89 (0.82, 0.96)	0.92 (0.85, 0.99)
Unknown	75/101 (74)	1.01 (0.89, 1.13)	0.98 (0.87, 1.10)
*p-value**		0.007	0.091
*p-trend**		0.003	0.030
Inclined to attend test as it is important to my health not to delay it (h)			
Strongly disagree/ disagree	79/113 (70)	ref.	ref.
Neutral	85/152 (56)	0.80 (0.66, 0.96)	0.85 (0.71, 1.01)
Strongly agree/ agree	1383/1873 (74)	1.06 (0.93, 1.20)	1.11 (0.99, 1.25)
Unknown	63/88 (72)	1.02 (0.86, 1.22)	1.01 (0.86, 1.19)
*p-value**		<0.001	<0.001
*p-trend**		<0.001	<0.001

Attended screen test assessed using Compass trial data.
ˆRelative risks (RRs) adjusted for age, employment status, highest education level, school, family history of cancer, state/territory of residence, SES of residence area, remoteness of residence, country of birth, screen attendance prior to recruitment to Compass trial and baseline HPV test result.
*"Unknown" categories excluded from tests to obtain p-values and p-trends.

during the pandemic (e.g. increased time due to reduction in working hours) made it more conducive for some women to screen. Despite this temporary increased attendance, screening rates decreased again in 2022.

The strengths of this study include a comprehensive analysis of factors on intention-to-attend and attendance, for a cohort due to screen over 2 years during the pandemic. Using linked data from screening registers to confirm screening history and attendance, adds further robustness to our findings. We tracked screening attendance and anxiety scores during the study, providing insights into attendance patterns over time for different age cohorts. However, participants in Compass-PLUS were part of a trial and results are subject to selection bias as routine screeners were more likely to participate and women with cervical cancer symptoms or having cancer treatment were excluded. Also, study participants were mainly residents of Victoria, hence, our results may not be generalizable to the wider eligible population for cervical screening in Australia. Compass-PLUS (and trial) participants were broadly comparable with NCSP screeners (AIHW, 2018) in terms of remoteness of residence and SES; the age distribution was comparable overall, but not between 25–34 years, as the younger ages were oversampled in the trial (Supplementary Figs. 2–4). National cervical screening data aren't yet available to compare screening patterns with Compass-PLUS. Regarding data from participants residing in Melbourne, it should be noted that Melbourne experienced five lockdowns by October'21 whereas fewer and shorter lockdowns were imposed on other Australian states (Macreadie, 2022). Another limitation is that we couldn't track the effect of lockdowns on attendance among all study participants as lockdown dates weren't documented for all regional areas. The number and duration of lockdowns differed between regional areas, mostly driven by local community infections, and varied from those imposed on Melbourne. We also didn't assess reduced availability/access to screening by GPs due to clinic closures from lockdowns. Expanded access to GP telehealth consultations in March'20 (Australian Gov, DHAC, 2023) and fewer face-to-face consultations would have

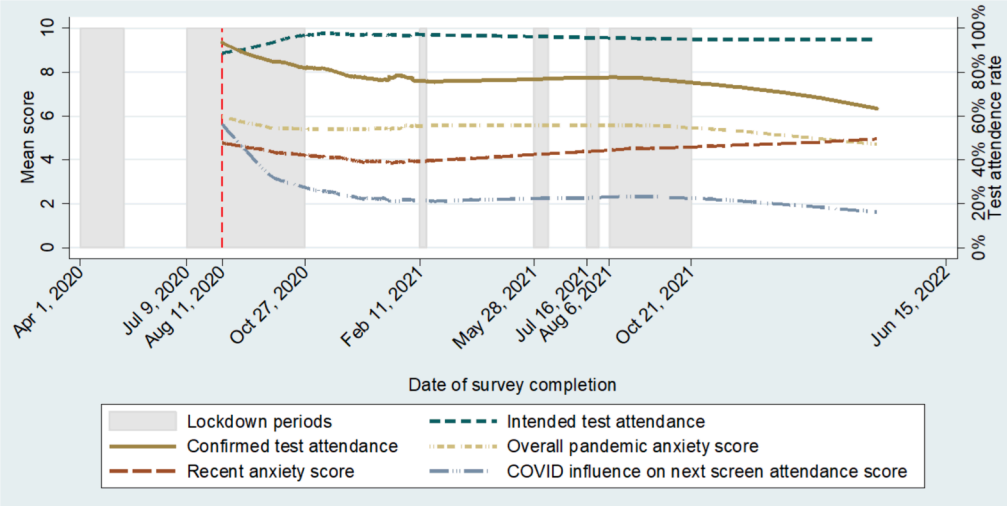

Fig. 2. Intended and actual cervical screen attendance rates, and mean anxiety related scores by date of COVID-19 survey completion in the older cohort, estimated using LOWESS smoother. Restricted to n = 704 participants of the Compass-PLUS study from Melbourne, the capital city of the state of Victoria, Australia (questionnaires completed Aug'2020 to June'2022). Note: While actual test attendance is graphed in relation to the date of the Compass-PLUS survey completion above, actual test attendance is assessed over a time interval between date of COMPASS survey completion to 6 months after invitation to Compass PLUS. Grey shaded sections indicate lockdown periods (Macreadie 2022).

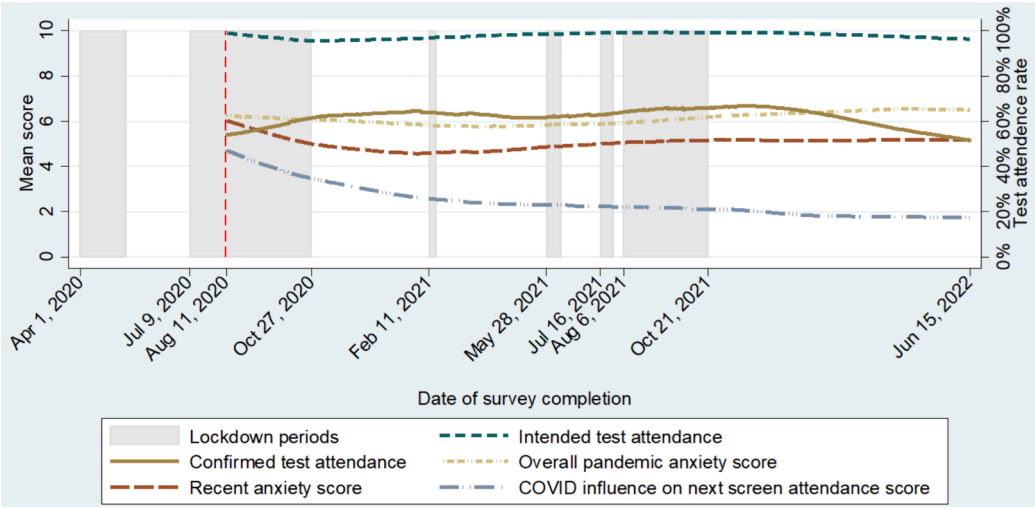

Fig. 3. Intended and actual cervical screen attendance rates, and mean anxiety related scores by date of COVID-19 survey completion in the younger cohort, estimated using LOWESS smoother. Restricted to n = 659 participants of the Compass-PLUS study from Melbourne, the capital city of the state of Victoria, Australia (questionnaires completed Aug'2020 to June'2022). Note 1: The lines in Fig. 3 reach further in time compared to those in Fig. 2, due to the last included participant in the older cohort completed her survey on the 5th of May 2022 while the corresponding participant in the younger cohort completed her survey on the 15th June 2022. Note 2: While actual test attendance is graphed in relation date of Compass-PLUS questionnaire completion above, actual test attendance is assessed over a time interval between date of questionnaire completion to 6 months after invitation to Compass-PLUS. Grey shaded sections indicate lockdown periods (Macreadie 2022).

resulted in a reduction in cervical screening. Finally, we set a 6-month window from the time of screen invitation to assess screening attendance. As the study is ongoing, additional data will be collected to distinguish between 'late-screeners' attending after this window and non-screeners, who missed their scheduled screen.

5. Conclusion

Our findings provide valuable insights into screening behaviours during the pandemic. Lower on-time screening attendance was associated with de-prioritisation of cervical screening. It is important that women who missed their screens under the renewed NCSP are identified and targeted efforts are made by GP practices for catch-up screens to be performed, offering the option of self-collection made universally available by the Australian government since 1st July'22. Our findings also highlight the need to plan for future emergencies, to enable the continuity of essential public health services including cancer screening. These plans should ensure equitable access to cancer screening and public communications on the importance of continuing screening to maintain early detection and treatment of cancer.

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manuscript.

CRediT authorship contribution statement

Louiza S. Velentzis: Writing – original draft, Supervision, Methodology, Conceptualization. **Sam Egger:** Writing – review & editing, Visualization, Formal analysis. **Jo Waller:** Writing – review & editing, Conceptualization. **Chloe J. Jennett:** Writing – review & editing, Project administration, Data curation. **Julia M.L. Brotherton:** Writing – review & editing. **Megan A. Smith:** Writing – review & editing. **Deborah Bateson:** Writing – review & editing. **Caitlin Rogers:** Writing – review & editing, Project administration, Data curation. **Amy Pagotto:** Writing – review & editing, Project administration, Data curation. **Rachel Skinner:** Writing – review & editing. **Natalie Taylor:** Writing – review & editing, Methodology. **Rhiannon Edge:** Writing – review & editing, Methodology. **Marion Saville:** Writing – review & editing, Resources. **Karen Canfell:** Writing – review & editing, Supervision, Resources, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: KC and MS are co-PIs of an investigator-initiated trial of cervical screening, (Compass; ACTRN12613001207707 and NCT02328872) run by the Australian Centre for the Prevention of Cervical Cancer (ACPCC), which is a government-funded not-for-profit charity; ACPCC has received equipment and a funding contribution from Roche Molecular Diagnostics. KC, MS and DB are also co-PIs on a major investigator-initiated implementation program Elimination of Cervical Cancer in the Western Pacific (ECCWP) which receives support from the Minderoo Foundation, and equipment donations from Cepheid Inc. Neither KC, MS, nor their institutions have received direct funding from industry for any project. MS holds NHMRC grants for 5 projects, is the Director for Cancer Council Australia and Co-chair of HPV test characteristics expert panel and consultant for Cancer Care Ontario. MS's institution, ACPCC, received donated HPV testing equipment for research purposes from the following companies: Roche, Seegene, Abbott, Becton Dickinson, Cepheid, AusDiganostics, Copan, Qiagen and Atila Biosystems. MAS reports salary support via fellowship grants from the NHMRC of Australia and Cancer Institute NSW and contracts paid to her institution (the Daffodil Centre) with the Commonwealth Department of Health (Australia) and National Screening Unit (New Zealand). The remaining authors have no conflicts of interests to declare.

Data availability

The authors do not have permission to share data.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2024.102849.

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