Analysis of individuals with a high number of contacts in the CoMix study

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Summary

- Individuals reporting more than 50 contacts in a day make up a small proportion (<3%) of the overall survey sample.
- The percentage of individuals reporting more than 50 contacts in a day has varied between 0% and 3% over the study, increasing from the first lockdown to a peak in September 2020 then decreasing to a minimum during the third lockdown, and increasing again to similar levels to last August following the end of the third lockdown.
- The percentage of individuals reporting more than 6 contacts has followed a similar pattern, varying between 2% during the first lockdown and 17% in September 2020.
- Variation in numbers of daily contacts has been higher in non-lockdown periods than in lockdown periods.
- Greater variation in numbers of contacts increases the potential for superspreading events (more details in forthcoming report on superspreading).
- Alongside the increase in mean contacts since the end of the third lockdown, there has been an increase in variation in numbers of contacts.
- This increase appears to have been driven primarily by an increase in contacts in schools and "other" settings (social, leisure and retail).
- Variation in numbers of contacts is currently at a similar level to when schools were reopened last year, despite mean contacts being lower.

Main

The percentage of individuals reporting more than 50 contacts in a day has been between 0% and 3% throughout the study period (Figure 1A and Table 1). We observed less than 1% of participants reporting over 50 contacts until August 2020, which coincides with a period of lowest restrictions and individuals returning to work. The percentage then increased from just over 1% to a peak of above 2.5% in September 2020 and stayed between 1% and 2% through the second lockdown until Christmas, when it reduced sharply. Thereafter, it remained below 1% until the third lockdown was lifted at the end of March, when it gradually increased again to around 2%. The percentages of individuals reporting more than 100 and 200 contacts follow a similar pattern but at smaller magnitudes. Overall, people reporting more than 50, 100, or 200 contacts make up a small proportion (<3%) of the total survey sample.

The percentage of individuals reporting more than 6 contacts in a day has varied in a similar pattern to the percentages reporting higher numbers of contacts from just below 2% in the middle of the first lockdown to over 16% in September (Figure 1B and Table 1). The percentages of individuals reporting more than 6, 10 and 30 contacts have increased since the end of the third lockdown, and are now at similar levels to August last year.
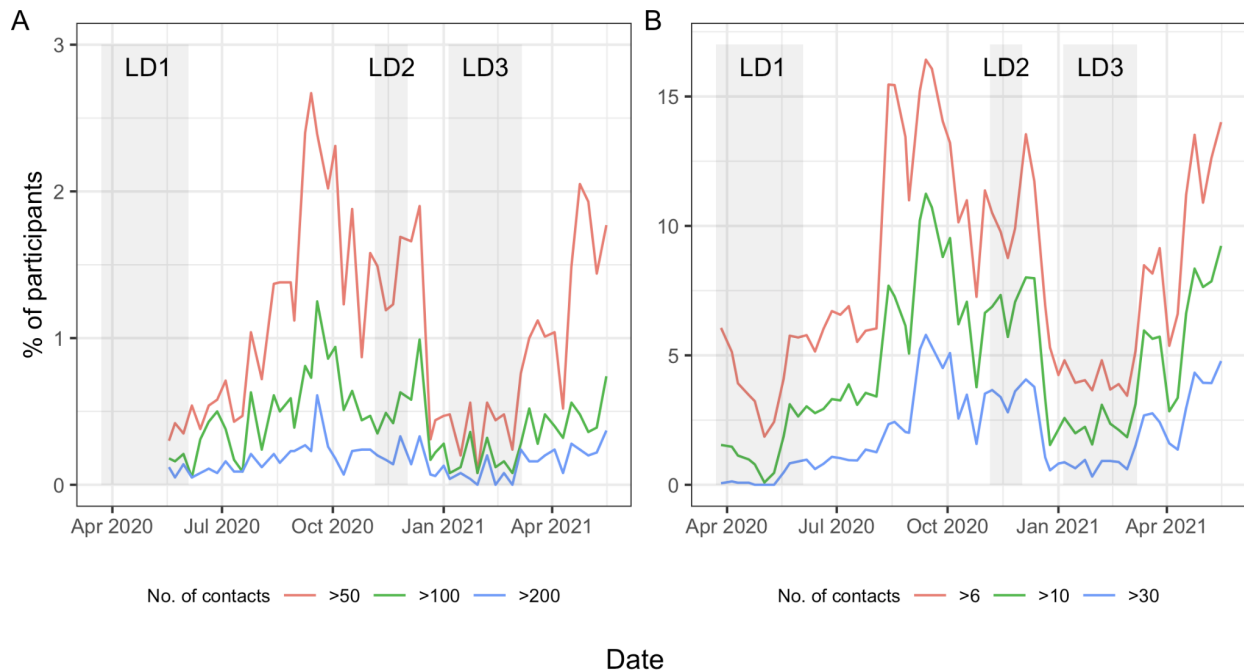

Figure 1: Percentage of individuals reporting (A) high and (B) lower numbers of daily contacts over time with lockdowns (LD) highlighted. Note different y-axes and different legends. Data for >50 contacts restricted to after May as mass contacts were not recorded prior to then.

Table 1. Percentage of participants with more than a certain number of contacts in different time periods based on lockdowns and different levels of restrictions in the UK over the past year.

| Period	Date range	Percentage of participants with >n contacts					
		n=6	n=10	n=30	n=50	n=100	n=200
1. Lockdown 1 (LD1)	23 Mar 2020 - 3 Jun 2020	4.2%	1.5%	0.3%	0.4%	0.2%	0.1%
2. Lockdown 1 easing	4 Jun 2020 - 29 Jul 2020	6.2%	3.3%	1.0%	0.6%	0.3%	0.1%
3. Relaxed restrictions	30 Jul 2020 - 3 Sep 2020	13.2%	6.3%	2.1%	1.3%	0.5%	0.2%
4. School reopening	4 Sep 2020 - 24 Oct 2020	13.5%	8.9%	4.4%	2.1%	0.8%	0.3%
5. Lockdown 2 (LD2)	5 Nov 2020 - 2 Dec 2020	9.5%	6.7%	3.3%	1.3%	0.5%	0.2%
6. Lockdown 2 easing	3 Dec 2020 - 19 Dec 2020	12.6%	8.0%	3.9%	2.0%	0.8%	0.2%
7. Lockdown 3 (LD3)	5 Jan 2021 - 7 Mar 2021	4.0%	2.2%	0.8%	0.4%	0.2%	0.1%
8. Lockdown 3 + schools	8 Mar 2021 - 31 Mar 2021	7.6%	4.7%	2.2%	1.0%	0.4%	0.2%
9. Step 2 + schools	16 Apr 2021 - 16 May 2021	11.8%	7.4%	3.7%	1.7%	0.5%	0.2%

The majority of large numbers of contacts are reported in work and school settings, with the percentage of individuals reporting >50 contacts at work following the same pattern as the percentage across all settings and the percentage reporting >50 contacts in schools reflecting the pattern of school openings (Figure S1). The high numbers of contacts tend to be reported amongst teachers, sales workers, managers, clerks, medical professionals and labourers (Table S1).
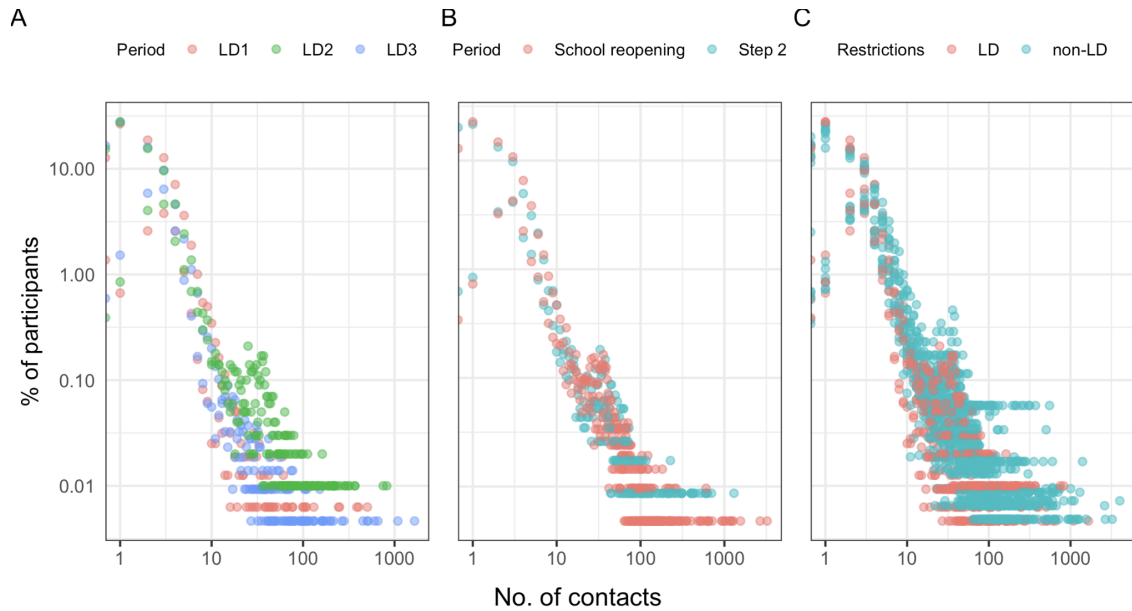
Figure 2. Distributions of total daily contacts for (**A**) **lockdown periods (B) school reopening vs Step 2, and (C) lockdown vs non-lockdown periods.** (A) There was greater variation in contacts when schools were open during lockdown 2 (green) compared to the other lockdowns (red and blue). (B) Variation in contacts is similar now to when schools were reopened in 2020. (C) Variation in contacts has been greater during non-lockdown periods than lockdown periods.
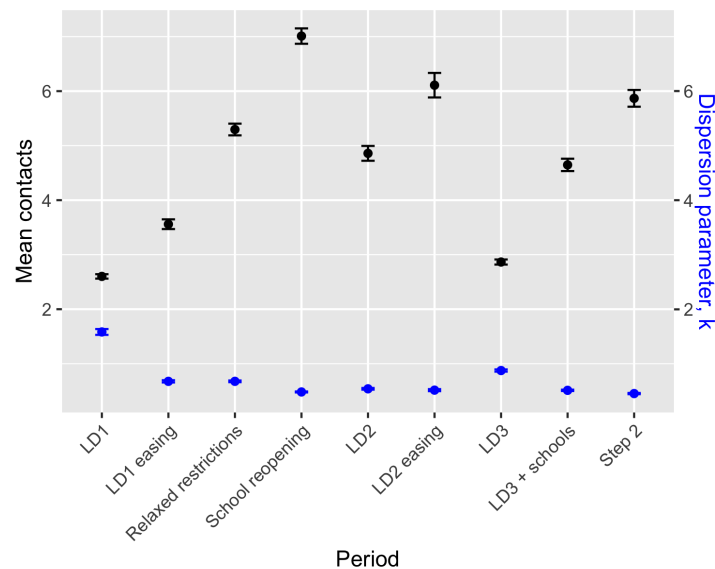
Figure 3. Estimates of the mean and dispersion of negative binomial distributions fitted to total daily contacts by period. The dispersion parameter k gives an indication of the variation in numbers of contacts, with smaller values corresponding to greater variation and values less than 1 corresponding to very large variation. Error bars show 95% confidence intervals.
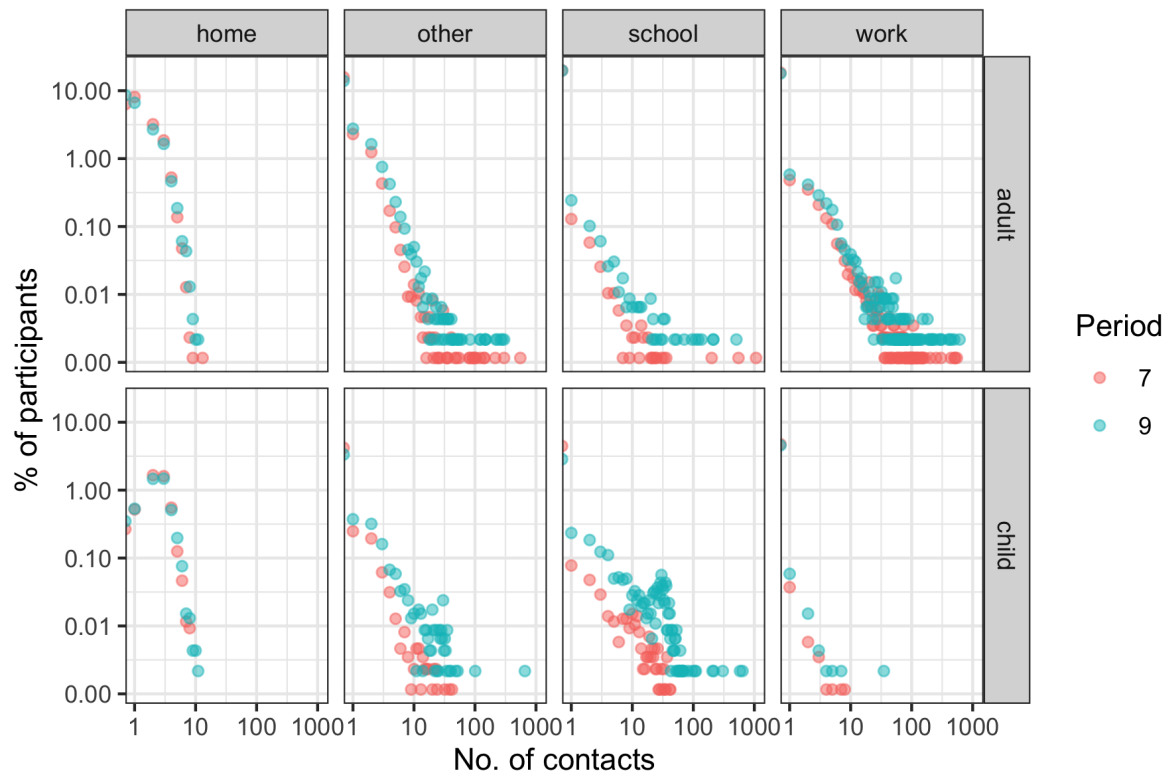
Figure 4. Contact distributions for adults and children during lockdown 3 (period 7) and Step 2 (period 9) by setting. The increase in the mean and variation of numbers of contacts since the end of lockdown 3 has been driven mainly by increases in school and "other" (social, leisure and retail) contacts and to a slightly lesser extent increases in work contacts for adults, while home contacts have remained stable.
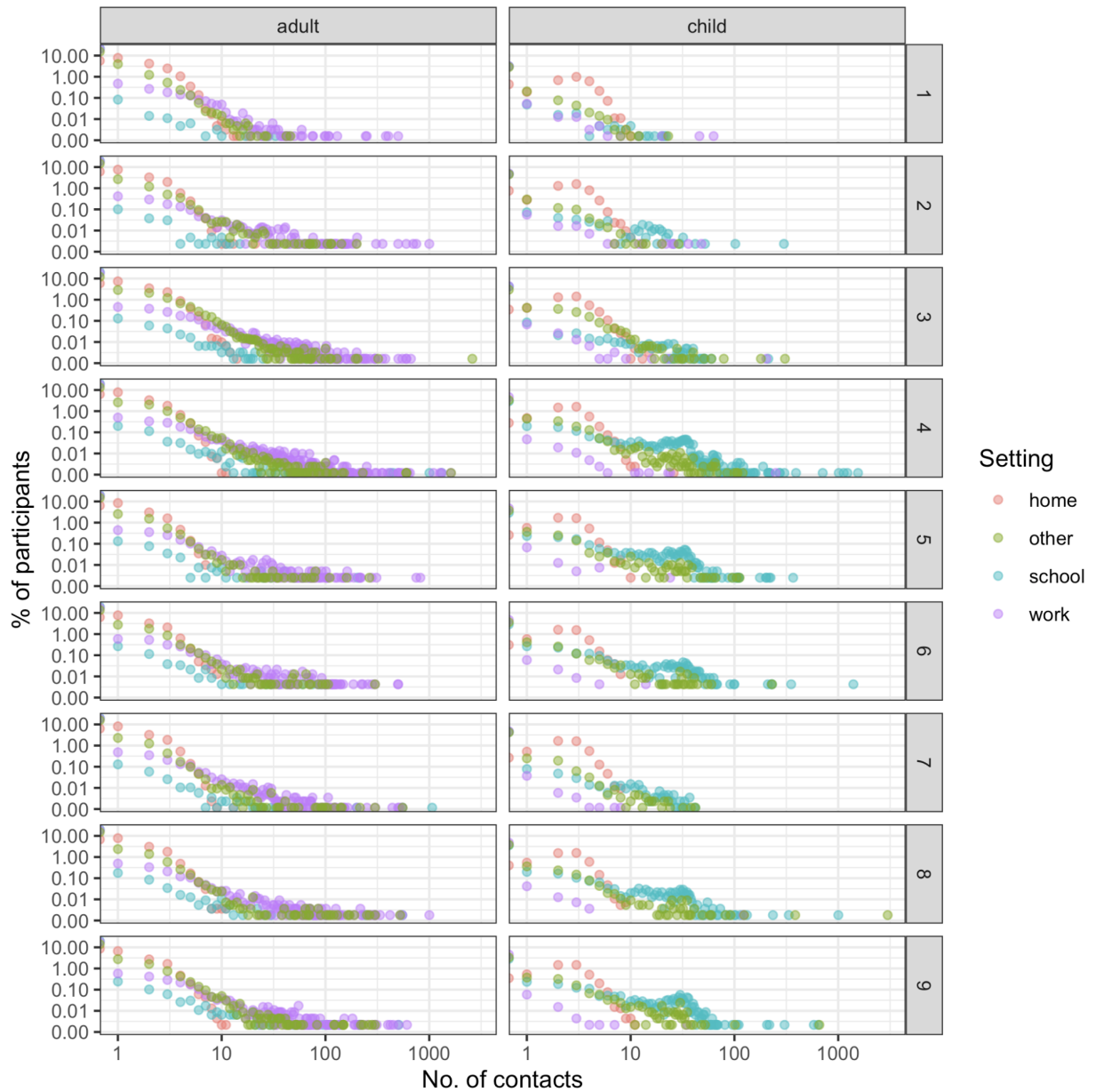
Figure 5. Contact distributions of adults and children in different time periods (rows) and settings. The longer tails in the distributions of work contacts (purple) for adults and school contacts (cyan) for children and contacts in "other" settings (social, leisure, and retail) are visible in non-lockdown periods when workplaces and schools were open (e.g. period 4).

Methods

Survey

CoMix is a behavioural survey, launched on 24th of March 2020. The sample is broadly representative of the UK adult population. Participants are invited to respond to the survey once every two weeks. We collect weekly data by running two alternating panels. Parents complete the survey on behalf of children (17 years old or younger). Participants record direct, face-to-face contacts made on the previous day, specifying certain characteristics for each contact including the age and sex of the contact, whether contact was physical (skin-to-skin contact), and where contact occurred (e.g. at home, work, while undertaking leisure activities, etc). Further details have been published elsewhere [2]. The contact survey is based on the POLYMOD contact survey [1].

Analysis

We calculated the percentage of participants reporting more than 6, 10, 30, 50, 100, and 200 contacts in the 24 hour period prior to filling in the survey. We compared these percentages over time to assess for changes over the previous year. We also calculated these percentages from nine time periods over the previous year representing different levels of restrictions (Table 1).

We compared contact distributions (overall and by setting and age) for recent data from the survey for the ninet time periods. For plotting contact distributions, we calculated the percentage of participants in each time period who reported a certain number of contacts to account for differences in numbers of participants per time period. We fitted negative binomial distributions to numbers of total daily contacts in the different time periods to estimate the mean and dispersion of the contact distributions.

The mean provides a measure of central tendency but is highly affected by skewed distributions. The dispersion parameter provides a measure of how much larger the variance is than the mean and is unaffected by changes in the magnitude of the mean. As the dispersion parameter k becomes large, the variance approaches the mean and the distribution approaches a Poisson distribution. Small values of k indicate that the variance is much larger than the mean and represent a shifting of mass to the tail of the distribution. This is referred to as overdispersion and is expected in reporting of numbers of contacts since they are bounded below by zero but typically include large numbers of contacts for a few individuals, giving a long tail to the contact distribution which greatly affects estimates of the mean number of contacts.

Funding

References

1.   Mossong J, Hens N, Jit M, Beutels P, AuranenK, Mikolajczyk R, et al. Social contacts and mixing patterns relevant to the spread of infectious diseases. PLoS Med. 2008;5: e74.
2.   Jarvis CI, Van Zandvoort K, Gimma A, Prem K, CMMIDCOVID-19 working group, Klepac P,et al. Quantifying the impact of physical distance measures on the transmission ofCOVID-19 in the UK. BMC Med. 2020;18: 124.

Appendix
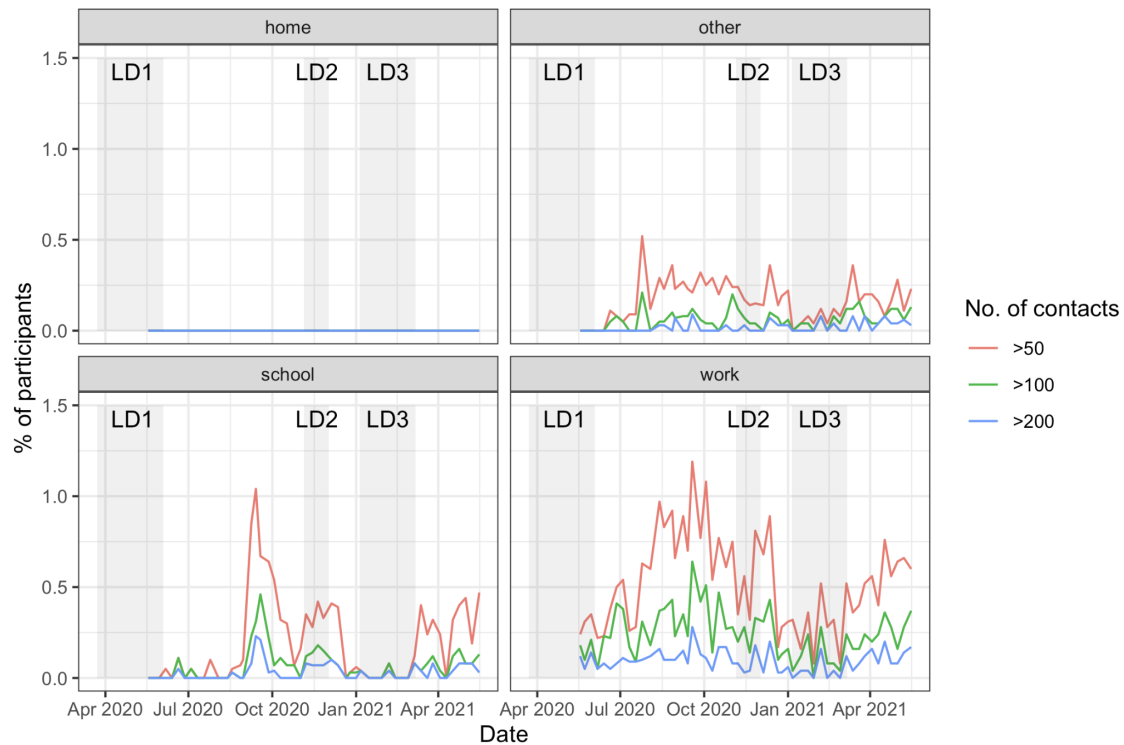
Figure S1. Percentages of participants reporting high numbers of daily contacts in different settings over the survey.

Table S1. The ten highest-frequency occupations of participants reporting more than 50 contacts in the previous day

Occupation	N
Teaching professionals	241
Sales and services elementary occupations	209
Customer services clerks	143
Office clerks	126
General managers in wholesale and retail trade	51
Nursing and midwifery professionals	46
Labourers in mining, construction, manufacturing and transport	45
Health professionals (except nursing)	37
Social work associate professionals	33
Housekeeping and restaurant services workers	33