Literacy and numeracy skills and life-course outcomes: Evidence from PIAAC and linked administrative data

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Abstract

This paper examines the life-course trajectories of NZ adults across different literacy and numeracy skill levels. This is done by using skill information for the working-age adult population (aged 16-65 years) collected in the Survey of Adult Skills (PIAAC). This sample is then linked with administrative data to track their life-course outcomes from 2008 to 2020. The outcomes of the one-fifth of NZ working-age adults who were assessed at below Level 2 in either literacy or numeracy (or both) are compared with those at or above this baseline.

It finds that adults with low measured skills have less favourable outcomes in a number of areas. They have lower rates of educational attainment, lower employment rates and average earnings, higher rates of hospitalisation, and higher rates of criminal offending and convictions. In addition, outcomes for Māori and Pacific peoples in both the low-skills and above-baseline groups are generally less favourable than those of their NZ European counterparts. For example, even among those with above-baseline skills, Māori and Pacific peoples have lower average earnings than NZ Europeans. These results provide a quantifiable evidence base regarding the role of literacy and numeracy skills with respect to a range of wellbeing outcomes over the course of an individual's life.

JEL Codes: I24, I26, J31, I14
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Introduction

We examine the life-course outcomes of those living with low literacy and/or numeracy (L+N) skills in New Zealand (NZ) using data from the 2014 Programme for the International Assessment of Adult Competencies (PIAAC) Survey of Adult Skills. Following OECD (2019a) and Erwin, Meehan, Pacheco, and Turcu (2020), we define those with L+N skills below Level 2 proficiency in PIAAC as having low skills. This represents about one-fifth or over half a million NZ working-age adults with low L+N skills. These data are then linked to administrative data in Stats NZ's Integrated Data Infrastructure (IDI) to examine outcomes over time for those with low L+N skills compared with a group with above-baseline skill levels.

Low L+N skills may affect an individual's well-being in a number of inter-related ways. For example, international research finds that individuals with low L+N skills are more likely to leave school early (Parsons and Bynner, 2005), experience lower levels of labour market attachment (Baldini Rocha and Ponczek, 2011; Chiswick, Lee, and Miller, 2003), have worse health outcomes (Kakarmath *et al.*, 2018) and higher offending rates (Bynner, 2009). These factors also interact with each other. For example, poor educational outcomes are associated with poor labour market outcomes, which are in turn associated with greater risk of criminal behaviour (Bynner, 2009).

The available evidence on the relationship between adult skills and life-course outcomes has been, however, limited due to a lack of longitudinal data. There is also some evidence on the skills of cohorts of young people and their subsequent life-course outcomes. For example, Polidano and Ryan (2017) uses data from Australia's Programme for International Student Assessment (PISA) to measure reading and mathematics skills of a representative sample of 15-year-old students, linked to longitudinal survey data. It finds no relationship between full-time employment rates or earning capacity at age 25 and reading proficiency at age 15. However, it uses longitudinal survey data with a high attrition rate of 75 per cent, which results in a relatively small sample size, limits sub-population analysis and raises the possibility of attrition bias. Two NZ papers Meehan, Pacheco, and Schober (2023) and Meehan, Pacheco, and Schober (2022b) appear to be the only studies which use PISA linked to administrative data to examine the relationship between young people's skills and their subsequent outcomes, including educational, labour market, family formation, physical and mental health and justice outcomes.

In terms of the relationship between adult skills and life-course outcomes, the available data and, consequently, the evidence is even more limited. Hanushek, Schwerdt, Wiederhold, and Woessmann (2015) use international PIAAC data to study labour market outcomes and find that the returns to skills are higher for prime-age compared to early-career workers. There is only limited information on other aspects of life within PIAAC, making it difficult to analyse the wider role of skills over the life cycle. Some countries have made advances in linking PIAAC to administrative data, including Canada, Germany and the Nordic countries (Denmark, Estonia, Finland, Norway and Sweden) (Maehler and Konradt, 2020). However, some of these linking projects are still in their early stages and

in cases where data are available, there has been limited use of it in research to date. For example, it appears that the analysis of the German linked data has been limited to methodological considerations of the linking approach (Daikeler, Gauly, and Rosenthal, 2020) and a comparison of earnings reported by PIAAC survey respondents and earnings from administrative data (Gauly, Daikeler, Gummer, and Rammstedt, 2020). Canada's linking of the Longitudinal and International Study of Adults (LISA) to PIAAC and administrative data, specifically tax, pension and immigration records, seems to be the most progressed, with the data being used in several papers (for example, see MacDonald, Arpin, and Quesnel-Vallée, 2022; Chatoor, MacKay, and Hudak, 2019; McLean, Bouaissa, Rainville, and Auger, 2019; Simard-Duplain and St-Denis, 2020; Zarifa, Seward, and Milian, 2019). However, it does not yet appear to have been used extensively, particularly in terms of examining lifecourse trajectories generally, and the relationship between skills and lifecourse trajectories specifically. This limited use may be due to data limitations – PIAAC 2012 was linked to the first wave of LISA, conducted in 2012, but only about 36 per cent of those in LISA 2012 also appearing in PIAAC 2012 (Simard-Duplain and St-Denis, 2020), which also raises questions of whether the overlapping sample was representative of the underlying population. For Norway, Barth *et al*. (2021) focuses on youth aged 16-24 who participated in PIAAC and examines the relationship between skills and NEET status two years after participating in PIAAC using PIAAC linked to administrative data. However, it does not examine adults in other age groups nor longer-term outcomes.

To the best of our knowledge, this is, therefore, the first study to use PIAAC linked to administrative data to examine the relationship between the skills of working-age adults (aged 16-65) and life-course outcomes. We follow individuals for two decades and examine a myriad of outcomes, including education, labour market, health and justice outcomes. We find that those with low L+N have less favourable education, labour market, health and justice outcomes than those with above-baseline skill levels.

Like Meehan, Pacheco, and Schober (2023), the relationships presented here are not causal in nature. For example, it may be that skills are causally linked to outcomes. However, there may be at least some element of reverse causation – for instance, employment in a role that has a high cognitive skill content may lead to an improvement in such skills. Alternatively, it may be that both skills and labour market, health and other outcomes are associated with unobservable attributes, such as the degree to which individuals discount the future. Or, some combination of all these factors may be at play.

In addition, while Meehan, Pacheco, and Schober (2023) follows a cohort of young people who are all aged 15 in 2009 for 11 years until 2020 with skills measured at the beginning of that period, this paper examines a nationally representative sample of adults who are aged between 16 and 65 in 2014 and examines their outcomes both before and after 2014. This, therefore, implicitly assumes that adults' skills do not change much over time. However, it should be kept in mind that it may also be the case that the time dimension of the influence of skills may run in both directions. For example, low L+N skills may be a precursor to leaving school early, but leaving school early may also have consequences for the developments of skills. Indeed, there is evidence that literacy and numeracy proficiency change over the lifespan as individuals age and over time (e.g.

Barrett and Riddell, 2016; Paccagnella, 2016; Desjardins and Warnke, 2012), and due to factors such as the characteristics of their jobs and workplaces (e.g. Billett, 2004; Skule, 2004), periods out of the workforce (e.g. Edin and Gustavsson, 2008) and their level of engagement with reading activities in everyday life (e.g. Reder, Gauly, and Lechner, 2020). Despite these limitations, the linking of PIAAC and administrative data provides an opportunity to gain insights into the life-course outcomes of adults living with low L+N.

The next section provides some background information on PIAAC and the linked administrative data used. Section 3 presents the main results. It first examines educational outcomes for those with low L+N skills versus those in the comparison group with above-baseline skill levels. It then examines labour market outcomes, followed by health and criminal activity outcomes. Section 4 concludes.

Background

This section provides background information on the PIAAC survey, the data used, and the characteristics of our population of interest.

PIAAC survey and skill levels

PIAAC Survey of Adult Skills, an Organisation for Economic Cooperation and Development (OECD) initiative, measures literacy and numeracy proficiency of the working-age adult population (aged 16 to 65 years). The survey design allows for comparisons across countries, languages, and cultures and it has been conducted in over 40 countries/economies.

PIAAC measures L+N proficiency on a 500-point scale that is converted into six proficiency levels, with below Level 1 being the lowest and Level 5 the highest. We define those with low L+N skills as being below Level 2 in either literacy or numeracy (or both). For literacy, those below Level 2 can perform tasks such as reading relatively short texts to locate a single piece of information, completing simple forms, understand basic vocabulary, determining the meaning of sentences and so forth. In contrast, those at Levels 4 and 5 can make complex inferences and appropriately apply background knowledge as well as interpret or evaluate subtle truth claims or arguments. Similarly, those below Level 2 in numeracy can complete tasks involving basic mathematical processes and perform simple processes involving counting, sorting and basic arithmetic. In contrast, those at Level 4 and 5 can understand a broad range of complex mathematical information (OECD, 2019a).

According to the 2014 cycle of NZ's PIAAC survey, just over one-fifth of NZ's working-age population were classified as having low L+N skills according to this definition. Comparing these shares internationally, NZ had relatively low shares of adults

with low literacy skills (about 12 per cent). Only five OECD countries had a lower share of adults below Level 2 literacy. While there is a high degree of correlation between literacy and numeracy scores (the correlation coefficient is 0.87), NZ does not compare as well to other countries in terms of numeracy. However, the share of adults below Level 2 was, at about 19 per cent, still less than the OECD average (OECD, 2019a). Despite this seemingly strong performance in international comparison, this still means that a sizeable share of NZ's working-age population has low L+N skills. Furthermore, as highlighted in Erwin, Meehan, Pacheco, and Turcu (2020), there are substantial differences in the share of those with low L+N skills across population groups. For example, the share is substantially higher among Māori and Pacific peoples.

Data and method

The Integrated Data Infrastructure (IDI) is a large research database managed by Stats NZ. It holds micro-data from various government agencies and surveys including PIAAC that can be linked at the individual level (Stats NZ, 2020). NZ participated in PIAAC in 2014 with 6,177 survey respondents.[1] Using the IDI, we can study life-course outcomes of respondents over time. We focus on their outcomes during their adulthood over the period 2008 to 2020, 7 years before to 7 years after participation in PIAAC.

We present the available data in three different ways. First, we follow individuals over time and compare skill groups in each calendar year. We do this for three age groups separately, to explore potential differences in life-course trajectories related to skills and age. This approach allows a clear distinction between whether an outcome is observed before or after the survey in 2014, when skills of participants are measured.

Second, we use the observable time period after the survey (2015 to 2020) to examine whether certain events ever occurred among all PIAAC participants. This allows us to analyse differences between skill groups even for outcomes that occur less frequently, such as mental health problems or court sentences.

Third, we pool all annual observations after the survey and regress outcomes on indicators for age, skill group, gender and year. The estimates are then used to calculate adjusted means (sometimes called predictive margins) for each age cohort. An advantage of this method is that it allows us to increase statistical power and paint a more precise picture of outcomes over the life cycle. The downside is that we observe skills only once per person and assign each person to a fixed skill group. This means we implicitly assume that skills do not change (much) as people age. Recall that PIAAC's population of interest are those aged 16-65 years. We restrict this pooled analysis to individuals aged 20 to 65, where this assumption that a person does not change skill groups may be more plausible compared to younger cohorts aged 16-19 years as many in this group will still be engaged

1 NZ also participated in the 2023/23 cycle. However, the data for that cycle were not yet available at the time of writing.

in secondary school education. However, it should be kept in mind that it may be the case that the relationship between skills and other outcomes is bi-directional. For example, low L+N skills may be a precursor to leaving school early, but leaving school early may also have consequences for the development of L+N skills. Likewise, L+N skill levels may influence which job a person has, but it is also the case that individuals who use L+N skills in their job are more likely to retain and develop these skills compared with those who do not use L+N skills at work, even if these individuals had similar L+N skill levels when entering the workforce. For example, Borgonovi, Choi, and Paccagnella (2018) finds that males' advantage in numeracy is relatively small in childhood but grows in adulthood, and suggests that a possible reason for this is that men are more likely to study and work in areas that make intensive use of numeracy skills given their over-representation in areas such as STEM.

We use multiple data sources to construct a range of outcome variables in addition to the information provided in PIAAC. The available observation period varies between data sets in the IDI. Most outcomes are available for our entire period of interest, 2008 to 2020, including income data from Inland Revenue (IR), injuries from Accident Compensation Corporation (ACC), hospitalisations, mental health problems and outpatient visits from the Ministry of Health (MoH) and criminal convictions from the Ministry of Justice (MoJ). Furthermore, we use data from the NZ Police on alleged offending (first full year 2010) and victimisation (2014). To analyse the participants' education, we use the complete history of educational enrolment, including tertiary education, industry training, and targeted training (starting in 2003) as well as compulsory education (starting in 2007) data from the Ministry of Education. Tables 9 and 10 in the Appendix provide a full list of the outcome variables of interest with their full descriptions.

PIAAC provides a set of 10 plausible values for literacy and 10 for numeracy. Similar to other international assessments such as PISA, PIAAC only collects a limited set of test answers from each respondent out of the full set of test items. To account for the resulting uncertainty of proficiency at the individual level, multiple imputation is used to construct plausible values based on information from the available test items and background questions (OECD, 2019b). All reported statistics are estimates generated using the Stata package Repest. Repest accounts for PIAAC's complex survey design by employing the Jackknife procedure with replicate weights for variance estimation and allows for the 10 plausible values for literacy and numeracy (Avvisati and Keslair, 2020).

There are some general limitations of PIAAC worth noting that are relevant to the present analysis. First, the survey is limited to measuring only specific aspects of literacy and numeracy. For example, literacy is based on understanding written texts and does not assess writing ability (PIAAC Literacy Expert Group, 2009). More generally, while this research focuses on L+N skills, it is important to keep in mind the potential for individuals with low L+N skills to possess other valuable skills such as communication skills, technical or job-specific skills, and so forth (Cochrane *et al.*, 2020; Erwin, Meehan, Pacheco, and Turcu, 2020). In addition, PIAAC was only administered in English in NZ.

Population characteristics

Our population of interest includes those who participated in PIAAC, could be identified in the IDI and live in NZ before or after the interview in 2014. To identify who resides in New Zealand, we build on Stats NZ's Administrative Population Census (APC). The APC determines usual residence based on activity in selected administrative data sources, mortality data, and international border movements (Stats NZ, 2021). Just over 91 per cent (5,628) of the 6,177 PIAAC 2014 participants are included in our analysis at some point (for information about the linkage methodology used by Stats NZ see Stats NZ, 2014). Those who are included in our analysis have very similar characteristics to the overall PIAAC sample - for example, the share of females, average age, the share born in NZ and other characteristics are almost identical between the two groups. Thus, bias due to the less than 100 per cent inclusion is unlikely to be much of an issue. This inclusion rate also compares favourably to, for example, the linking of German PIAAC data with administrative data from Germany's Integrated Employment Biographies (IEB). In the German case, 72 per cent of participants consented to the data linkage, and of these, 87 per cent could be identified in the IEB, resulting in a linkage rate of 63 per cent. Moreover, in the case of Germany, those who could be linked had different characteristics to those who could not be linked, such as higher average educational and skill levels (Daikeler, Gauly, and Rosenthal, 2020).

For the included individuals, we construct an annual panel of PIAAC participants covering the years 2008 to 2020 based on the APC resident population. Of the 5,628 participants who appear in our panel at any point in time, these restrictions result in between 5,061 and 5,535 individuals in our population of interest per year, representing between 2.2 and 2.6 million NZ residents aged 16-65 at the time of the interview in 2014.

About one-fifth (20.6 per cent) of the population are considered to have low skills according to PIAAC 2014, that is, their numeracy or literacy skills are less than Level 2. Table 1 compares the characteristics of this group to the residual group with skills above this baseline level. Females are overrepresented among those with low skills. About 56 per cent of the low-skills group are women, compared with 51 per cent of those with above-baseline skills. This contrasts with the cohort of 15-year-old students from PISA examined in Meehan, Pacheco, and Schober (2023), where boys were more likely to have low reading and/or mathematics skills due to similar proportions of boys and girls at the lowest levels of mathematics proficiency, but many more boys who did not reach Level 2 in reading. However, these PISA results combined with the current PIAAC findings are consistent with cross-country research on the evolution of skills over the life-course. In particular, this research finds that boys have higher numeracy skills than girls and that this gap increases with age, peaking at age 27, while girls have a small literacy advantage over boys but this gap closes over time and is negligible by age 27 (Borgonovi, Choi, and Paccagnella, 2018).

Those in the low-skilled group are also about 2 years older on average. This reduction in skills with age is as expected, and existing research suggests it is due to a combination of higher education levels among younger cohorts and because cognitive skills tend to peak at about age 25-30 before declining (see for example Calero, Murillo

Huertas, and Raymond Bara, 2019). This also highlights that the possibility of cohort effects should be kept in mind when interpreting the results in Section 3.

Those with low L+N skills are also four percentage points less likely to be born in NZ. This contrasts with Meehan, Pacheco, and Schober (2023), which finds 15-year-old students with low skills are more likely to have been born in NZ. This could be because the PIAAC test was administered in English only, and adults who were not born in NZ may, on average, have lower English language proficiency than those born in NZ, while this difference may be less apparent among the PISA cohort who are more likely to have migrated to NZ at a young age. Finally, those of Māori, Pacific peoples and Asian ethnicity are overrepresented among those with low skilled, while NZ Europeans are underrepresented.

Results

Education

Turning to our main results, we first look at educational outcomes. Since many PIAAC participants undertook education before the PIAAC survey, we look at educational attainment measures from the PIAAC survey in addition to outcomes measured in the IDI. PIAAC responses can include overseas education and qualifications attained prior to 2014 (when the survey was conducted). In contrast, the IDI administrative data on education includes NZ education and qualifications undertaken during the time period covered by administrative databases (2007 onwards for secondary school enrolments, 2003 onwards for enrolment in tertiary education, industry and targeted training,[2] July 1984 onwards for secondary school qualifications, October 1997 onwards for tertiary qualification completions).[3] As such, the coverage will be incomplete for many – for example, a PIAAC participant who was 50 at the time of the survey in 2014 would have completed school before 1984, when the secondary school data on obtained qualifications that is available in the IDI begins. Therefore, we focus more on educational enrolment information rather than educational attainment from the IDI.

Table 2 shows that, according to the PIAAC background questionnaire, those with low L+N skills have fewer years of education on average than those with above-baseline skills (12.2 years versus 14.3 years). They are also less likely to have a post-school qualification (46 per cent versus 68 per cent). In terms of IDI enrolment data, a lower share

2 Targeted training is industry training at sub-degree levels in targeted areas.
3 Within the IDI, information on highest qualification obtained, which includes foreign qualifications, are available from non-administrative sources, including the Census and some surveys, such as the Household Labour Force Survey.

of those in the low-skills group have been enrolled in any form of tertiary education at any point covered by IDI records (62 per cent compared with 71 per cent of the above-baseline group). Looking only at bachelor's degrees reveals even larger differences, with about three times as many of the above-baseline group having been enrolled in a bachelor's degree qualification compared with the low-skills group (23 per cent versus 8 per cent). The low-skills group are more likely to have enrolled in targeted training than the above-baseline group (16 per cent versus 6 per cent). There is no statistically significant difference between the low-skills and above-baseline groups in enrolment in industry training, with about a fifth of both groups having enrolled at some point.

Table 1. Characteristics by skill group

	(1) Low skills	(2) Above-baseline	(3) Difference	(4) p-value
Female	0.56	0.51	0.05	0.038
Age	41.54	39.68	1.86	0.002
Born in NZ	0.68	0.73	-0.06	0.008
Ethnicity				
NZ European	0.54	0.81	-0.27	0.000
Māori	0.23	0.11	0.12	0.000
Pacific Peoples	0.17	0.04	0.13	0.000
Asian	0.15	0.11	0.04	0.009
Middle Eastern/Latin American/African	0.01	0.01	0.00	0.662
Other Ethnicity	0.00	0.01	-0.00	0.044

Notes: This table compares average characteristics of those with low skills (Column 1) and those with above-baseline skills (2) for PIAAC participants who are ever in the population of interest. Column 3 shows the difference between skill groups, Column 4 shows the p-value testing the equality of the two means. The number of observations is 5,628. All observation counts are randomly rounded to base 3 in accordance with Stats NZ confidentiality rules.

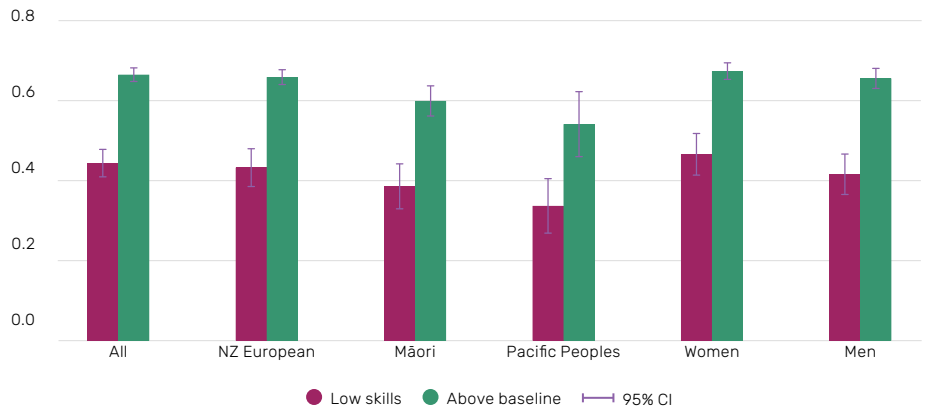
Table 2. Educational enrolment and attainment

	(1) Low skills	(2) Above-baseline	(3) Difference	(4) p-value
Educational attainment from PIAAC				
Years of education	12.17	14.34	-2.17	0.000
Any post-school qualification	0.46	0.68	-0.23	0.000
Enrolment information from IDI				
Tertiary education	0.62	0.71	-0.09	0.000
Bachelor	0.08	0.23	-0.15	0.000
Industry training	0.22	0.23	-0.01	0.568
Targeted training	0.16	0.06	0.09	0.000

Notes: This table compares average outcomes of those with low skills (column 1) and those with above-baseline skills (2). Column 3 shows the difference between skill groups, column 4 shows the p-value testing the equality of the two means. Enrolment information from IDI refers to ever being enrolled at any point in time covered by the available records.

Figure 1 further decomposes whether individuals have a post-school qualification based on PIAAC responses by gender and ethnicity reveals that Māori and Pacific peoples in both the low-skills and above-baseline groups are less likely to have a post-school qualification than their NZ European counterparts, although the differences for the low-skills groups are not statistically significant. There are no statistically significant differences between men and women for either the low-skills or above-baseline groups.

Figure 1. Any post-school qualification



Part of the reason for the difference in education levels between the low-skills and above-baseline group could be because the low-skills group are, on average, older, and education levels have increased over time resulting in younger people being more highly educated on average than older people. However, this is very unlikely to explain the entire difference in educational outcomes between the low-skills and above-baseline groups given the difference in average age between the two groups is only 1.5 years (see Table 1). In addition, other research where age is not a factor finds similar educational outcome differences. For example, following a cohort of young people who were all 15-years-old in 2009, Meehan, Pacheco, and Schober (2023) finds similar differences in educational outcomes by skill level, with 17 per cent of the young people with low skills having enrolled in a bachelor's degree by 2020 at age 26, compared with 55 per cent of those in the above-baseline group.

Labour market

This section analyses labour market outcomes. It examines employment, occupation, earnings and benefit receipt.

Employment

Figure 2 presents employment rates by age. We examine tax records back to 2008 and therefore focus on those aged 36 and over at the time of the PIAAC survey as those aged 36 would have been 30 in 2008 and therefore very likely to have completed formal education. For analysis that focuses on a cohort of young people over time, see Meehan, Pacheco, and Schober (2023).

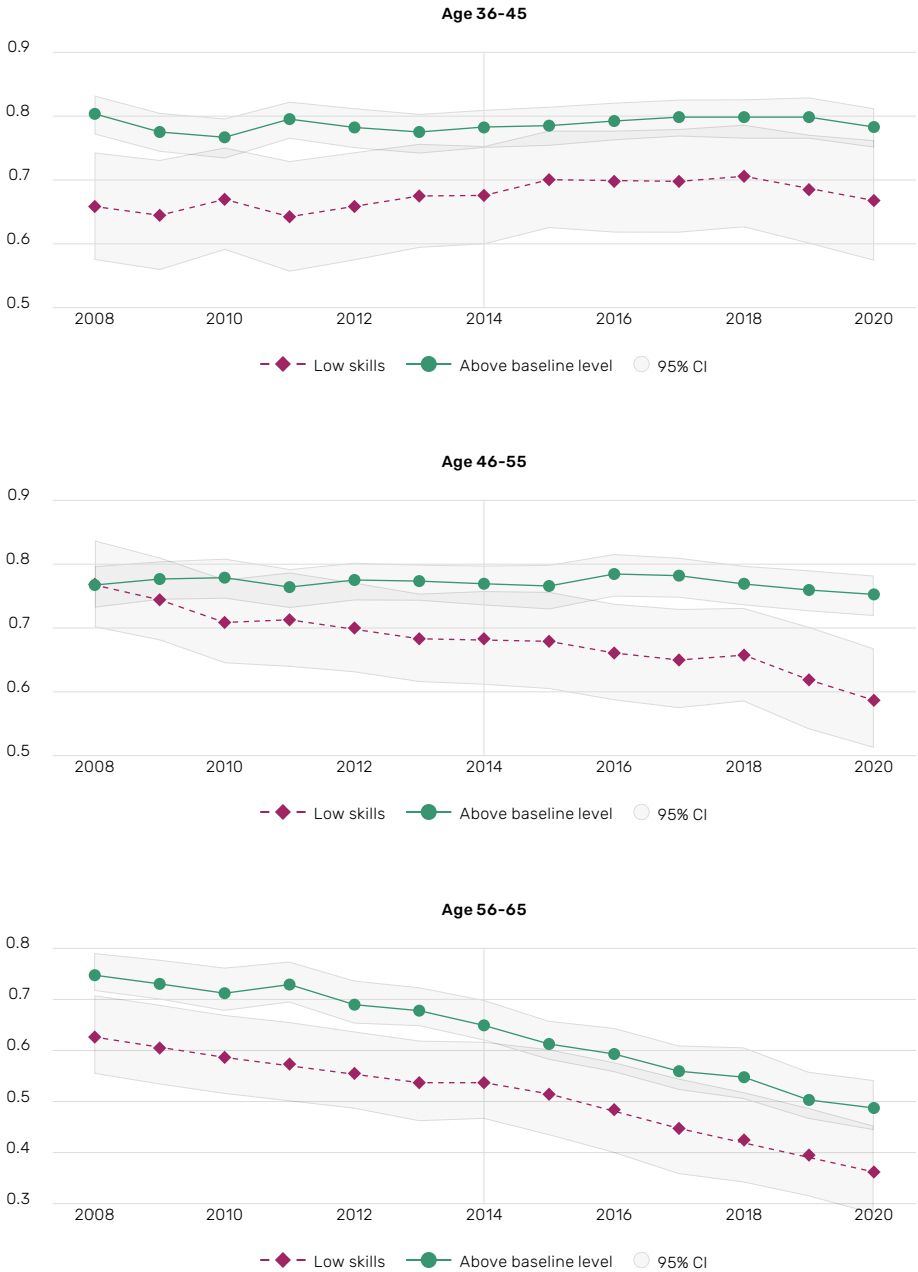
The left-hand panel of Figure 2 tracks those aged 36-45 at the time of PIAAC in 2014 back to 2008 and forward to 2020. It shows that those in the low-skills group have lower employment rates by about 10 to 15 percentage points than those in the above-baseline group, and the differences are statistically significant in most years.

Employment rates for those aged 46-55 in 2014 were similar among the low-skills and above-baseline groups in 2008, after which the employment rates among both groups fell, but they fell by more in the low-skills group. This may reflect that by 2020, the group were aged 52-64 years old, so some may have stopped working as they got older, with this more likely in the low-skills group who are also more likely to work in physical jobs (see 'Occupation' results below). However, the differences are only statistically significant from 2016 onwards. Moreover, skills and education are positively correlated and previous NZ research has found that higher educated older women (aged over 50) are more likely to participate in the labour market than less educated older women, although no statistically significant association was found between education and participation for men (Gorman, Scobie, and Towers, 2012).

For those aged 56-65 in 2014, the employment rates of both groups fell throughout the 2008 to 2020 period. While the low-skills group in this age category also have lower employment rates than the above-baseline group, the differences are generally not statistically significant.

Given we are examining people who have already spent some time in the labour force by the time they took the PIAAC assessment in 2014, reverse causation may also be part of the explanation for the positive association between employment and L+N skill levels. Previous research has shown that there is a negative relationship between time out of the workforce and skills (Edin and Gustavsson, 2008). In addition, skills increase with the use of those skills - for example, Reder, Gauly, and Lechner (2020) finds that literacy proficiency develops as a by-product of people's engagement in everyday reading and writing practices. Moreover, those in jobs where they use their literacy and numeracy skills may be more likely to retain their skill levels over time. For example, Borgonovi, Choi, and Paccagnella (2018) finds that the numeracy gap between young men and women increases as they age, and highlights that this is consistent with a greater specialisation of men in occupations that make more intensive use of numeracy skills. Therefore, reverse causation may also have a part to play: working more over one's lifetime, particularly in roles requiring L+N skills, may lead to greater measured skill level in PIAAC in 2014, and thus contribute to the observed positive association between employment and skill levels.

Figure 2. Employment indicators for different age groups

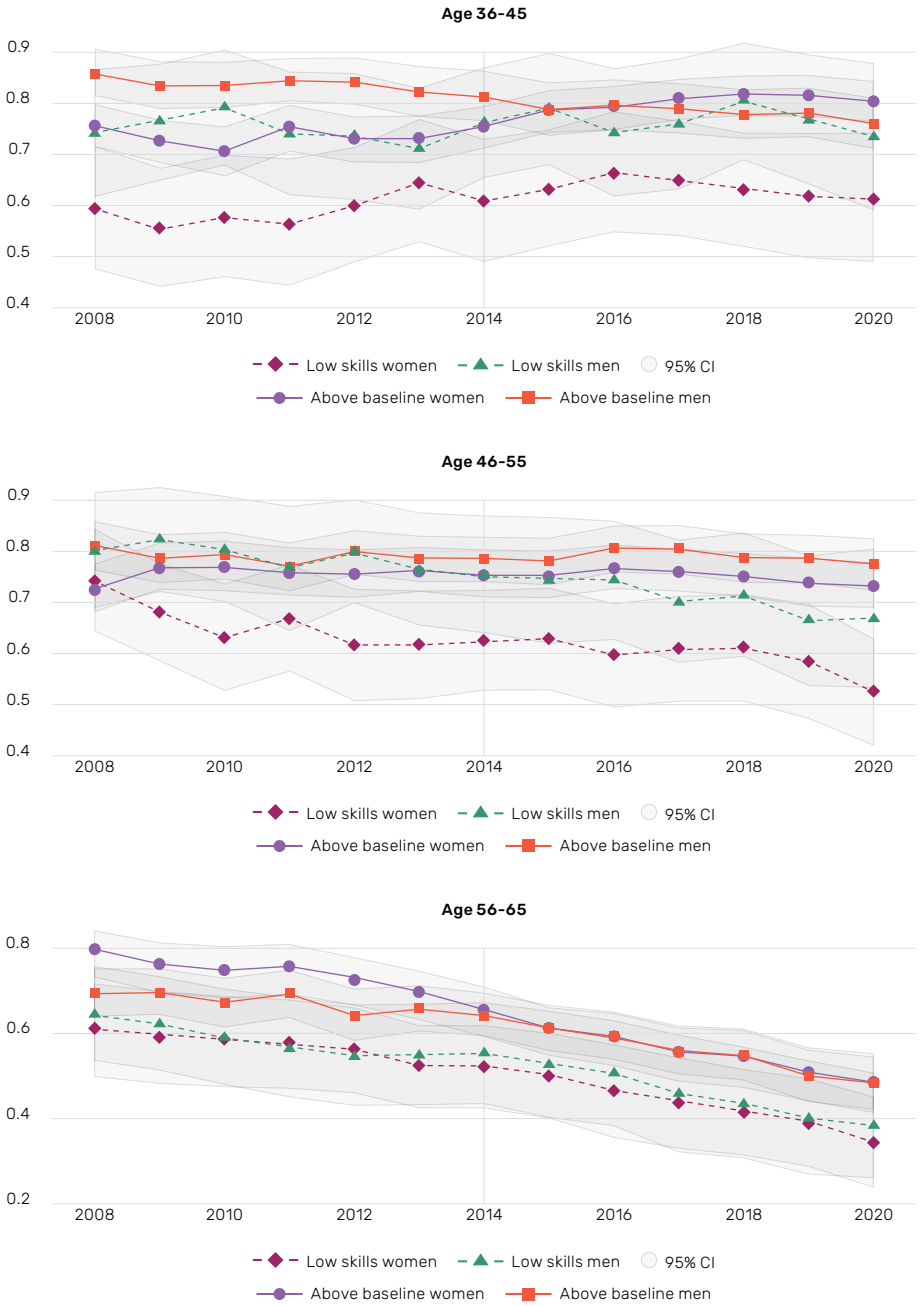


These employment patterns may differ by gender. As discussed in Meehan, Pacheco, and Schober (2023), differences in employment rates by skill level and gender could reflect differences in family formation patterns, for example. Consistent with Meehan, Pacheco, and Schober (2023), the group with the lowest employment rates tends to be women with low skills (see Figure 3). This difference is more pronounced among those aged 36-45 in 2014. When they are aged 30-39 years in 2008, their employment rates were lower than the other groups, including above-baseline women. This reinforces the idea that this may, at least in part, reflect parenthood patterns as their employment rates were particularly low when they were at an age when they were more likely to have young children, and these employment rates then increased over time. Consistent with this idea, Meehan, Pacheco, and Schober (2022a) show that women with low skills tend to have a higher average number of children than those in the above-baseline group.

In contrast to the results for women, the employment rate of men with low skills is more similar to men in the above-baseline group, with many of the differences not being statistically significant. For those aged 36-45 in 2014, men in the low-skills group have lower employment rates than men in the above-skills group in 2008, but their employment rates are relatively stable over time, while those of men in the above-skills group fall gradually so that the employment rates of the two groups converge over time.

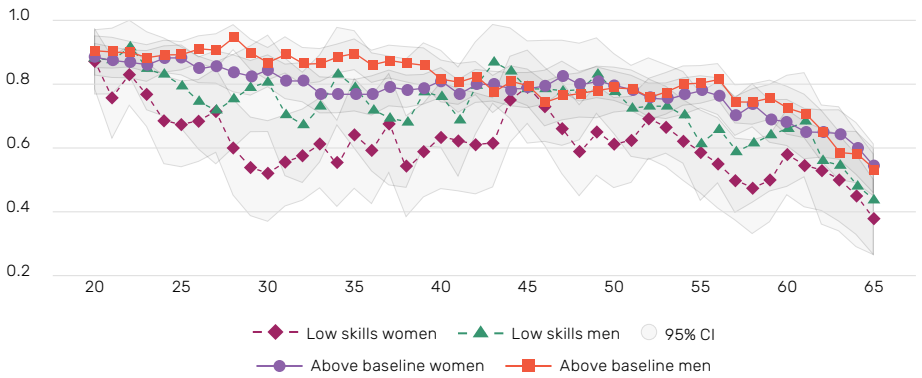
For those aged 46-55 years in 2014, the employment rates of both men and women with low skills fall over time while that of men and women with above-baseline skills do not. For those aged 56-65, the employment rates of all groups fall over time, which is expected as individuals begin to retire. Once again, many of the differences between the groups are not statistically significant.

Figure 3. Employment indicators for different age groups



To increase the statistical power of the group comparisons, as described in Section 2.2, Figure 4 pools all annual observations and regresses outcomes on indicators for age, skill group, gender and year. The adjusted means are then calculated to give employment rates across these dimensions. This shows that women in the low-skills group have the lowest employment rates, with the share employed decreasing as they age until about the age of 40, when their employment rate increases somewhat and only starts to decline again from about the age of 50. In contrast, the employment rates of women with above-baseline skills decrease slowly from the age of 20 before dropping more quickly after they are in their mid-50s. For men, those with above-baseline skills have higher employment rates than those with low skills when they are young, but this gap disappears in their late 30s as the employment rates of men with above-baseline skills decrease. However, as they enter their later working years, the employment rate of men with low skills starts to fall earlier and faster than that of men with above-baseline skills.

Figure 4. Any employment by age for different skill groups



Occupation

Table 3 presents occupation information from PIAAC 2014 data for those who are employed. Those in the low-skills group are more likely (relative to the above-baseline group) to be service workers and shop and market sales workers; plant and machine operators and assemblers; craft and related trades workers; elementary occupation workers, and less likely to be technicians and associated professionals; legislators, senior officials and managers; and professionals. For example, 8 per cent of workers in the low-skills group are professionals versus 24 per cent of those in the above-baseline group. There are some differences by gender. Women in the low-skills group are more likely to be service and shop and market sales workers, while men in the low-skills group are more likely to be craft and related trades workers.

Table 3. Occupations

	All		Women		Men	
	(1) Low skills	(2) Above-baseline	(3) Low skills	(4) Above-baseline	(5) Low skills	(6) Above-baseline
Service workers and shop and market sales workers	0.23*	0.13	0.38*	0.20	0.07	0.07
Plant and machine operators and assemblers	0.13*	0.04	0.06*	0.01	0.20*	0.07
Craft and related trades workers	0.13*	0.09	0.03	0.02	0.24*	0.16
Elementary occupations	0.11*	0.05	0.11*	0.04	0.12*	0.06
Technicians and associate professionals	0.11	0.15	0.07*	0.15	0.15	0.15
Legislators, senior officials and managers	0.08*	0.18	0.08*	0.14	0.09*	0.22
Professionals	0.08*	0.24	0.12*	0.28	0.05*	0.20
Clerks	0.08	0.10	0.13	0.16	0.04	0.04
Skilled agricultural and fishery workers	0.03	0.02	0.03	0.01	0.04	0.03

Notes: This table compares average outcomes of people with low skills and those with above baseline skills for different groups of the population. * indicates that the difference between skill groups is statistically significant at the 5% level. Occupational information for 2241 women and 1884 men comes from PIAAC.

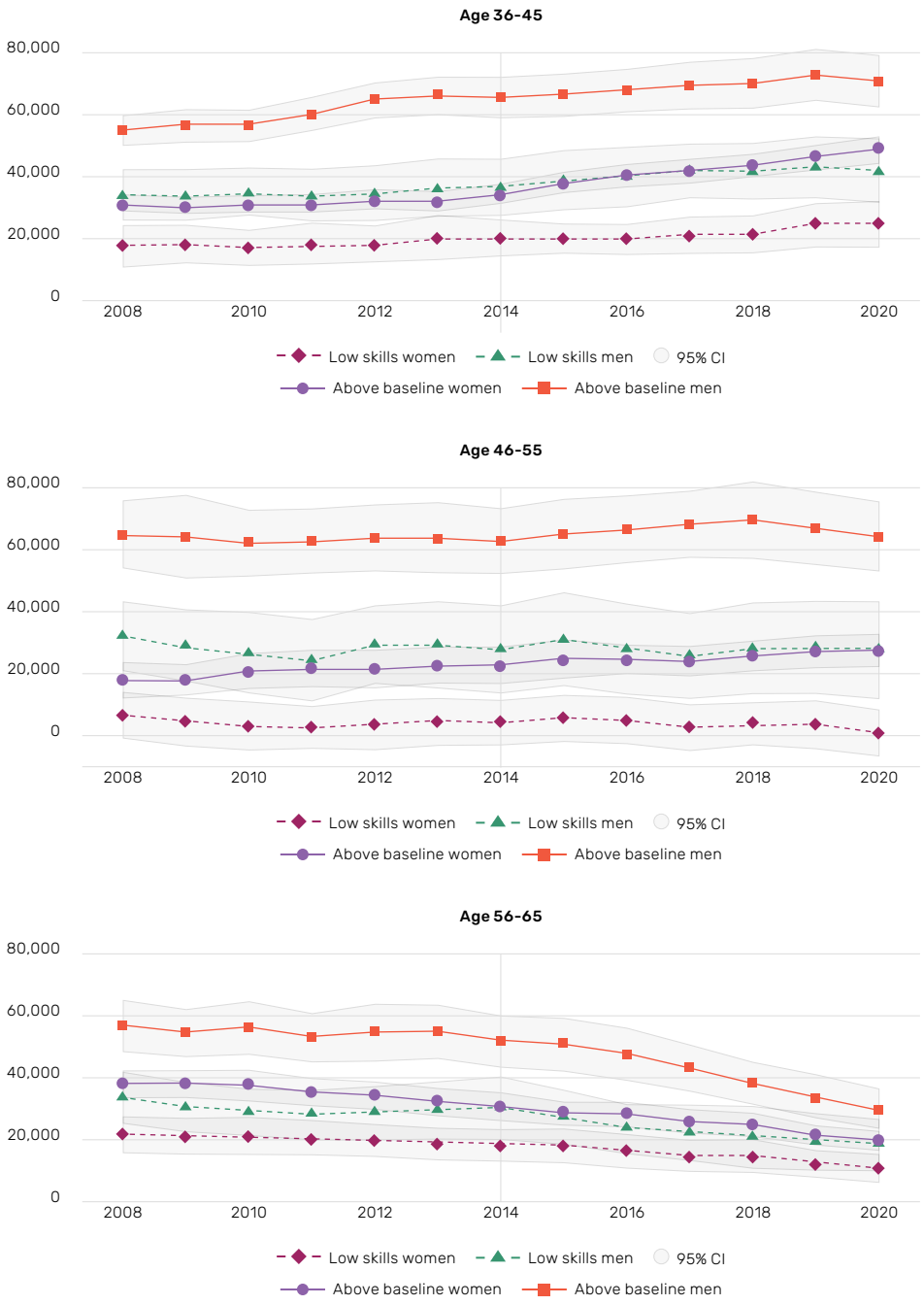
Earnings

We next look at earnings using tax data. All earnings are measured in 2020 prices using the consumer price index to adjust for inflation. Figure 5 presents earnings over time by age groups and gender. Those aged 36-45 in 2014 experience increases in earnings over time between 2008 (when they were 30-39 years old) and 2020 (when they were 42-51 years old), as expected as they gain work experience. Average earnings are highest among men with above-baseline skills, and their earnings growth is stronger than the other groups over time, leading to an increasing gap between this group and the other groups. Men with low skills have similar earnings over time to women with above-baseline skills. Above-baseline women have little growth in average earnings until about 2013. Women with low L+N skills have the lowest earnings and experience little earnings growth over time.

Those aged 46-55 in 2014 also experience some increases in earnings over time, although the rate of increase is slower than for the 36-45 year group, which is consistent with the expected pattern of larger earnings increases during the first years of entering the labour market. Once again, men with above-baseline skills have the highest average earnings, and women with low skills have the lowest.

For those aged 56-65, their average earnings are generally decreasing over time, with the rate of decrease increasing over time. This is as expected due to an increasing share of this group entering retirement over time.

Figure 5. Earnings for different age groups



These patterns of average earnings by age are even clearer in Figure 6 which pools the observations and shows adjusted means by skill groups, age and gender. The left-hand panel of Figure 6 shows that earnings generally increase steeply when individuals are young, followed by slower earnings growth, then a plateau followed by a decrease in earnings. This is as expected as individuals gain experience, enter their prime earning years, then begin to retire. This pattern is most pronounced for above-baseline men. The average earnings of men with low skills follows a similar pattern as those of above-baseline men, but at a much lower level. Women with above-baseline skills experience similar earnings growth as men with above-baseline skills for a few years when they are young before their earnings growth plateaus at a much younger age than for that of men. Women with low skills have low average earnings regardless of age and do not experience a strong increase in earnings when they are young as the other groups do, but instead have a slow increase in earnings by age up until they are in their late 40s.

To get a sense of the degree to which the patterns in the left-hand panel are due to employment rate differences by age, the right-hand panel restricts attention to those who are working. Across all groups, average earnings conditional on working are more positively correlated with age than the unconditional average earnings. For example, for above-baseline men, earnings do not start to decrease until about age 60. This also reveals that the average earnings of above-baseline women are still much lower than above-baseline men and are not, therefore, simply due to lower employment rates among women. Similarly, the average earnings of women with low skills is still much lower than that of men with low skills.

Figure 6. Earnings and earnings conditional on working by age for different skill groups

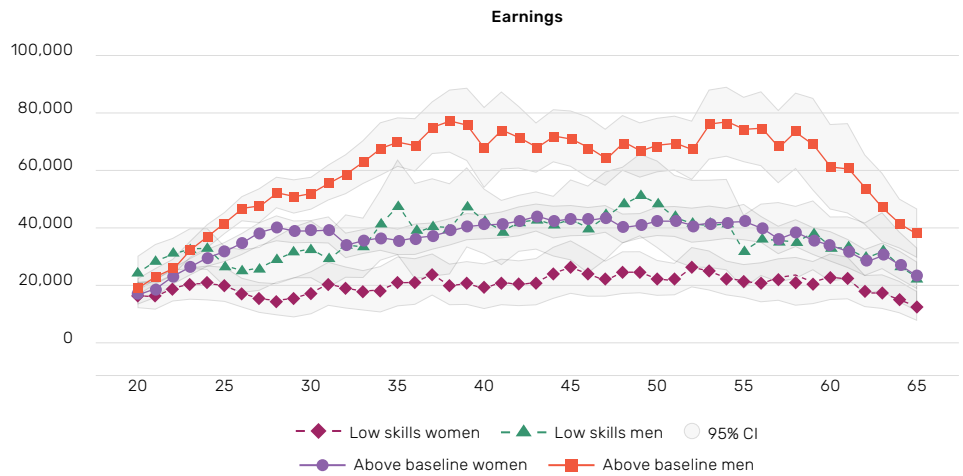


Figure 6. continued

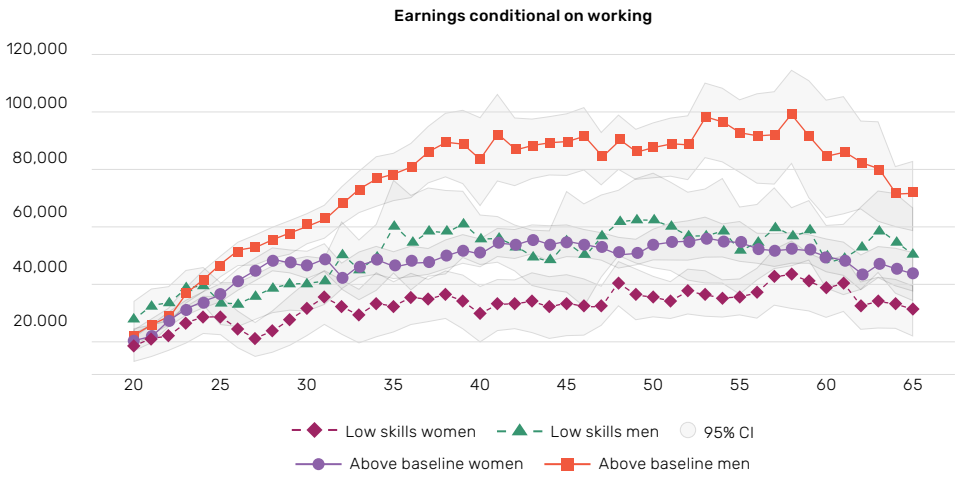
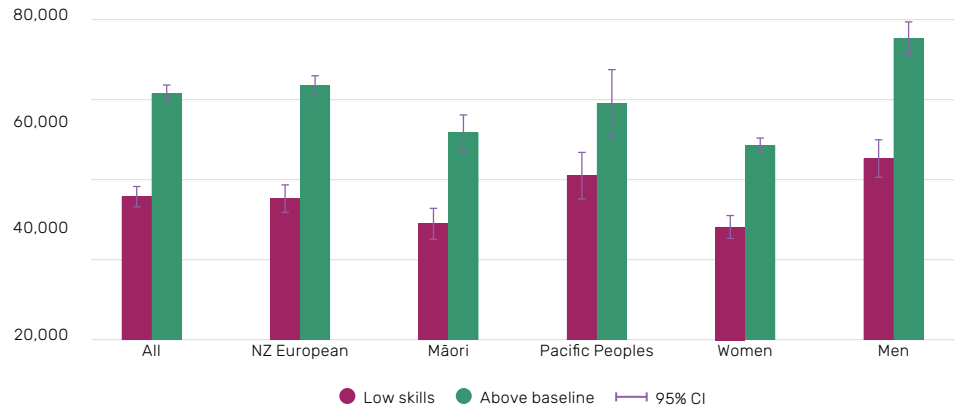


Figure 7 shows earnings by gender and ethnicity, where earnings is measured as the highest annual earnings we observe for an individual between 2015 and 2020. As discussed, men with above-baseline skills have higher earnings than women with above-baseline skills. The earnings of women with above-baseline skills are actually only slightly higher than that of men with low skills (and the difference is not statistically significant). Turning to ethnicity, NZ Europeans with above-baseline skills have the highest average earnings, followed by Pacific peoples with above-baseline skills, then Māori with above-baseline skills. For those with low skills, there is no statistically significant difference between NZ Europeans and Pacific peoples while Māori have lower average earnings.

Figure 7. Highest observed earnings



Benefit receipt

Figure 8 shows benefit receipt and average benefit payment amounts by age decomposed by skill level and gender, based on Ministry of Social Development (MSD) data on the receipt of a main benefit. This is based on the adjusted means for the pooled data. Women with low skills are more likely to receive a main benefit than men with low skills, while men with above-baseline skills are the least likely to receive a benefit. The share receiving a benefit tends to be highest when individuals are young. For example, the share receiving a benefit decreases over time for all four groups, although it increases after the age of about 50, with this increase being particularly strong among men with low skills. The average amount of benefit payments is also highest among women with low skills and lowest among men with above-baseline skills. This likely not only reflects the higher share receiving benefits among women with low skills, but also that those with dependent children generally receive higher benefit payments. For example, the vast majority of those receiving a sole parent benefit are women (91.3 per cent in the June 2022 quarter according to Ministry of Social Development, 2022). The amount received starts falling sharply at age 65 as people become eligible for NZ Superannuation and this replaces their receipt of a benefit.

Figure 8. Benefit receipt by age for different skill groups

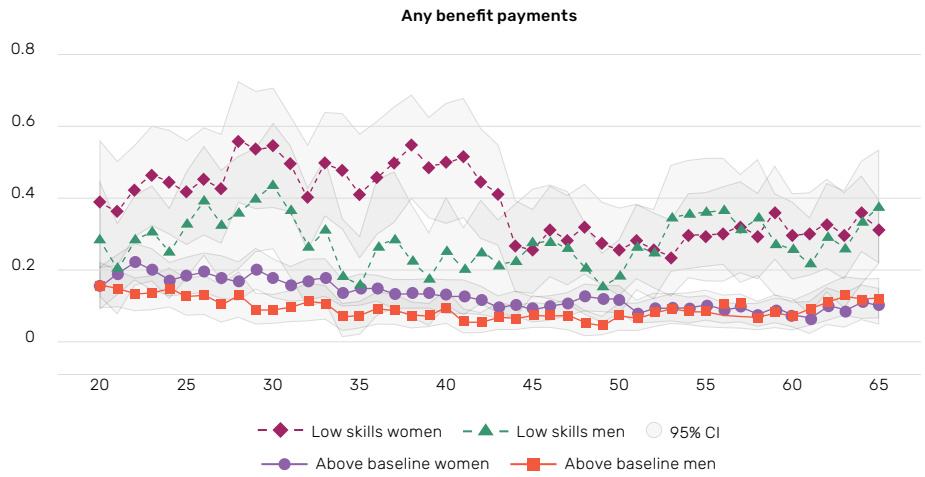


Figure 8. continued

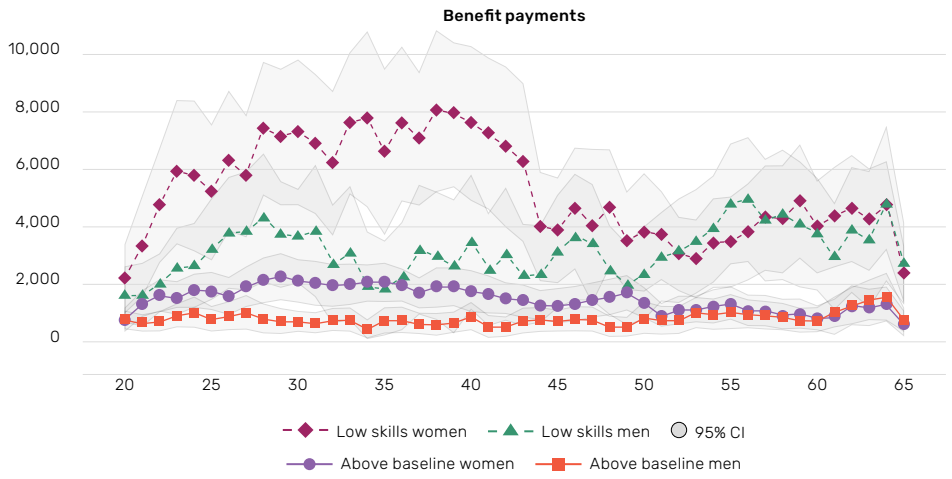
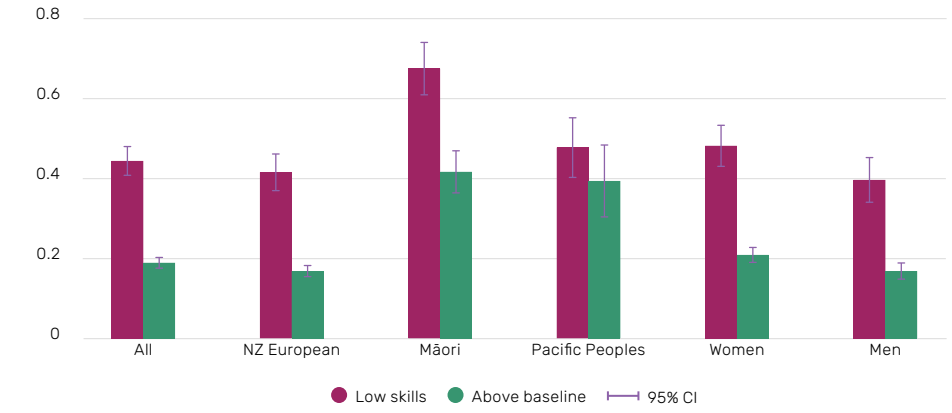


Figure 9 shows the share of individuals who have ever received a main benefit between 2015 and 2020 by gender and ethnicity. Consistent with Figure 8, women are more likely to have received a benefit than men within each of the skill groups. In terms of ethnicity, NZ Europeans with above-baseline skills are the least likely to ever have received a benefit. The rates of benefit receipt are higher for Māori and Pacific peoples. For example, Māori and Pacific peoples with above-baseline skill levels are more likely than NZ Europeans with low skills to have received a benefit (although the differences are not statistically significant).

Figure 9. Share of people who ever received benefits



Health

Another outcome that the existing literature highlights is associated with skill level is health. As such, this section examines hospitalisation, injury and mental health outcomes based on Ministry of Health data. Existing research highlights that higher literacy levels are associated with a range of health outcomes via a number of potential pathways. For example, people with low literacy tend to be less responsive to traditional health education messages, are less likely to use disease prevention services and are less able to successfully manage chronic disease (Berkman, Sheridan, and Donahue, 2011; Dewalt *et al*., 2004).

The measures of health care usage presented here are used as proxies for an individual's state of health. While health status and health care usage are likely highly correlated, health care usage is, in fact, a combination of actual health status and the propensity to access health care (as discussed in Meehan, Pacheco, and Schober, 2022b). For example, if those with above-baseline skills are more likely to access health services in the event of illness or injury than those in the low-skills group, and we find that those with low skills have higher health care usage, then the health care usage measures will be an underestimate of the true difference in health status between the two skill-level groups. However, the results presented below showing that health care usage is generally higher among those with low skills compared with the above-baseline group is in line with self-reported health status collected as part of PIAAC. For example, Scott (2018) finds a positive relationship between self-report health status and skill and education levels.

General health care use

Figure 10 shows the rate of hospitalisation by age groups. In general, those in the low-skills group have higher hospitalisation rates, although the differences are not statistically significant in general. The hospitalisation rates for the 36-45 years group are decreasing slightly over time, which is particularly evident among the above-baseline group. For those in the 46-55 year group, hospitalisation rates increase over time as the group ages, with this pattern being even more pronounced among the 56-65 year age group.

Figure 10. Share of people with hospitalisations for different age groups

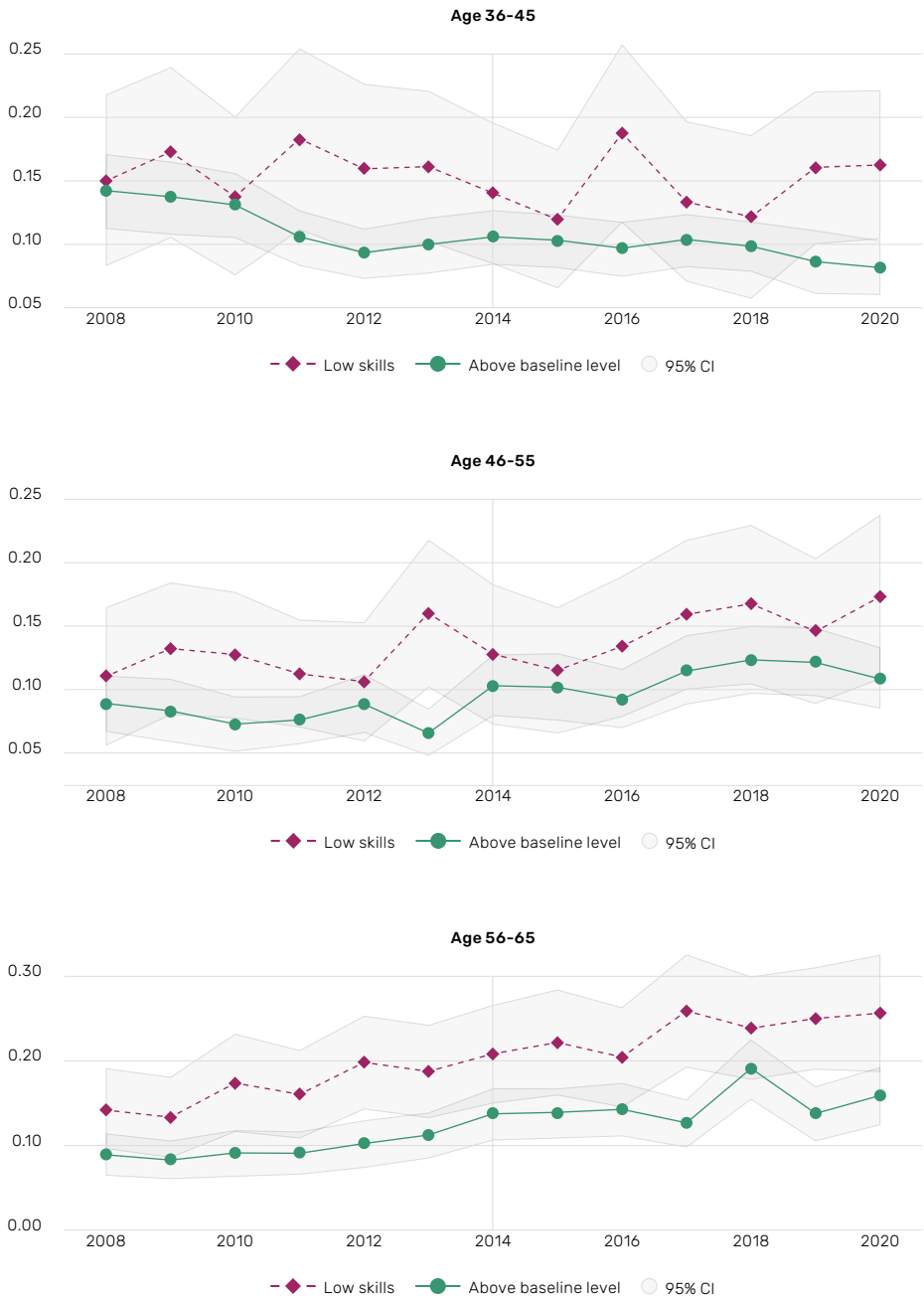


Table 4 shows health care utilisation over the 2015-2020 period and provides more details of the nature of the treatment. As in Figure 10, the rate of hospitalisation for any reason is higher among the those with low skills. Almost 53 per cent of the low-skills group have been hospitalised at least once during this time period, compared with 40 per cent of the above-baseline group. This could partly be because the birth rate among those with low skills is higher (Meehan, Pacheco, and Schober, 2022a). Therefore, the second row of Table 4 looks at hospitalisations excluding child birth, and finds that there is still a large and statistically significant gap between those with low and above-baseline skills (48 per cent versus 35 per cent). Looking at selected diagnosis groups, the hospitalisation rate for every diagnosis group is higher among the low-skills group, although the difference is only statistically significant at the 5 per cent level for musculoskeletal, digestive and nervous system and skin, tissue and breast issues. The share who have had at least one non-admitted secondary care event is also higher among those with low skills.

Once again, these differences in health care utilisation most likely reflect a combination of differences in health status and propensities to access health care. For example, the higher rate of emergency department visits among those with low skills could reflect poorer health status, but could also partly be because those with lower skills may have less access to primary health care for a variety of reasons.

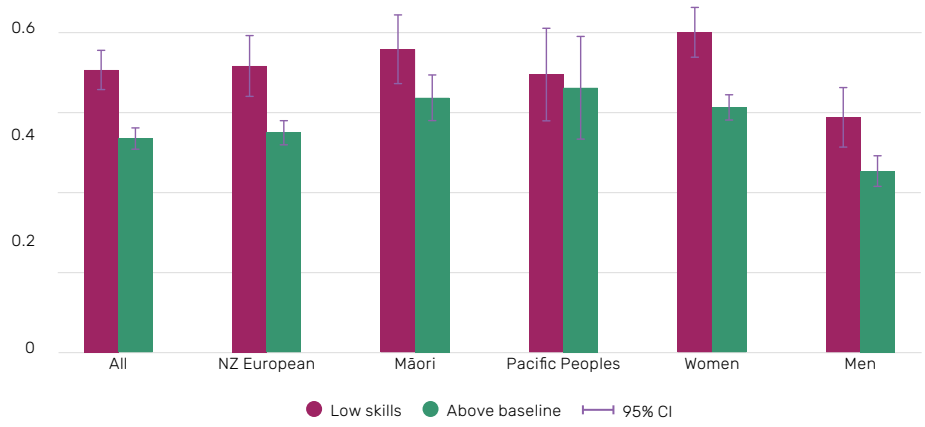
Table 4. Health care utilisation

	(1) Low skills	(2) Above-baseline	(3) Difference	(4) p-value
Hospitalisation	0.53	0.40	0.13	0.000
Hospitalisation (excl. childbirth)	0.48	0.35	0.13	0.000
Selected diagnosis groups				
Musculoskeletal system	0.08	0.04	0.04	0.000
Digestive system	0.12	0.09	0.03	0.037
Injuries	0.13	0.09	0.04	0.002
Ear, nose, mouth and throat	0.05	0.03	0.01	0.220
Nervous system	0.04	0.03	0.02	0.074
Skin, subcutaneous tissue and breast	0.07	0.04	0.03	0.000
Non-admitted secondary care events				
Any event	0.73	0.62	0.11	0.000
Emergency department visits	0.51	0.38	0.13	0.000
Other outpatient visits	0.63	0.51	0.12	0.000

Notes: This table compares health care utilisation for people with low skills (column 1) and those with above baseline skills (2). Column 3 shows the difference between skill groups, column 4 shows the p-value testing the equality of the two means.

Decomposing the share of those who have had any hospitalisation between 2015 and 2020 by gender and ethnicity shows that the hospitalisation rate is higher among women compared to men. Men (women) with low skills are more likely to have had at least one hospitalisation than men (women) with above-baseline skills. Looking at ethnicity, Māori have higher hospitalisation rates than NZ Europeans. While there is a statistically significant difference in hospitalisation rates between those with low skills and above-baseline skills for NZ Europeans and Māori, the difference is not significant for Pacific peoples.

Figure 11. Share of people with any hospitalisations



Injury

Examining injuries using ACC data, Figure 12 shows that there is no discernible differences in overall injury rates between those with low skills and those with above-baseline skills. Decomposing this by injury type (Table 5) and restricting attention to the post-PIAAC 2015-2020 period, those with low skills have higher rates of work injuries, which is as expected given they are more likely to be employed in physical roles (see 'Occupation' results in subsection 3.2). However, they are less likely to have sports injuries than their above-baseline counterparts. These results are consistent with Meehan, Pacheco, and Schober (2022b), which follows a cohort of 15-year-old students and finds there is no statistically significant difference in overall injury rates by skill level, but those with low skills have higher work injury rates and lower sports injury rates than those with above-baseline skills.

Figure 12. Share of people with any injuries for different age groups

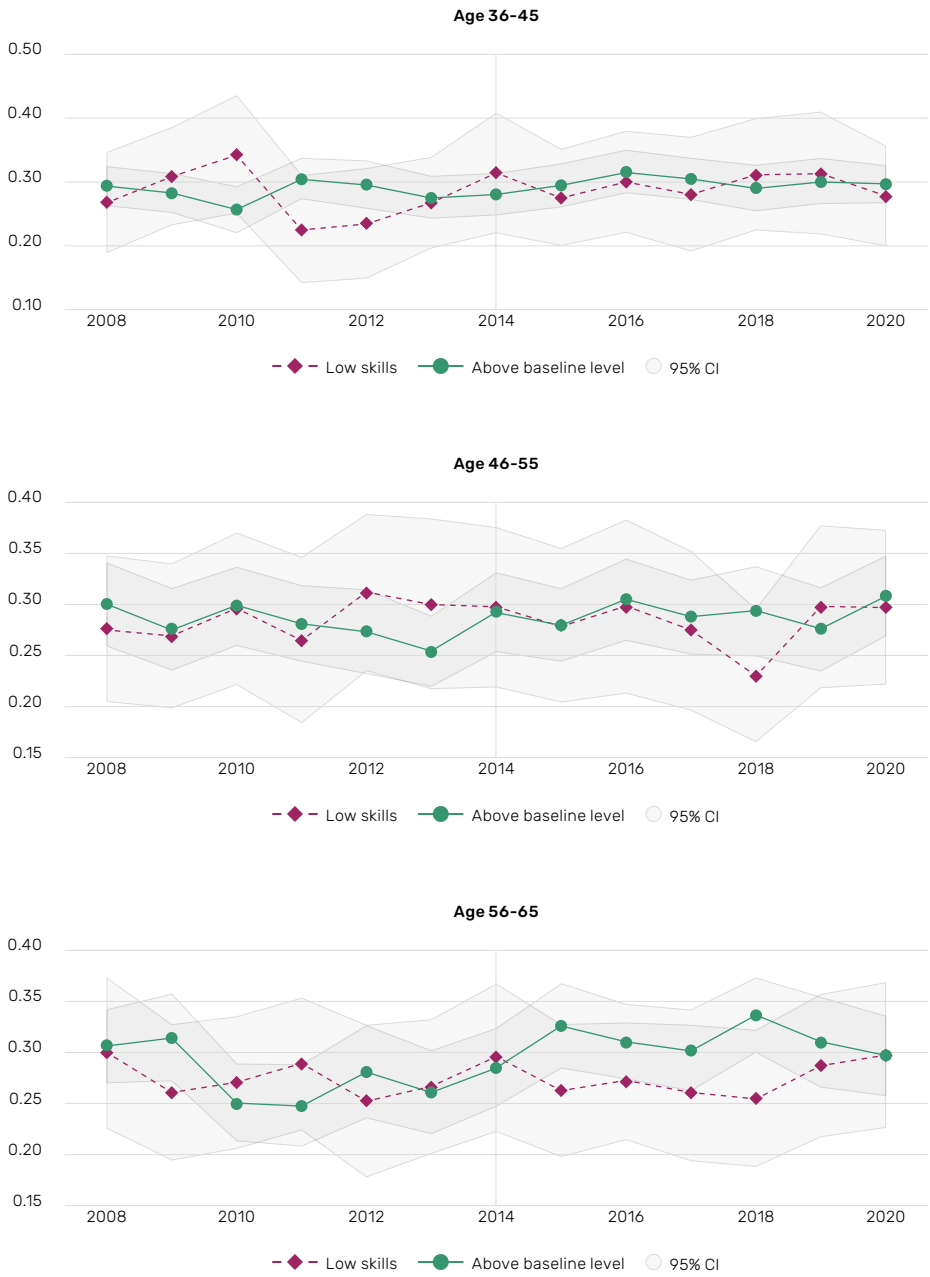


Table 5. Injuries

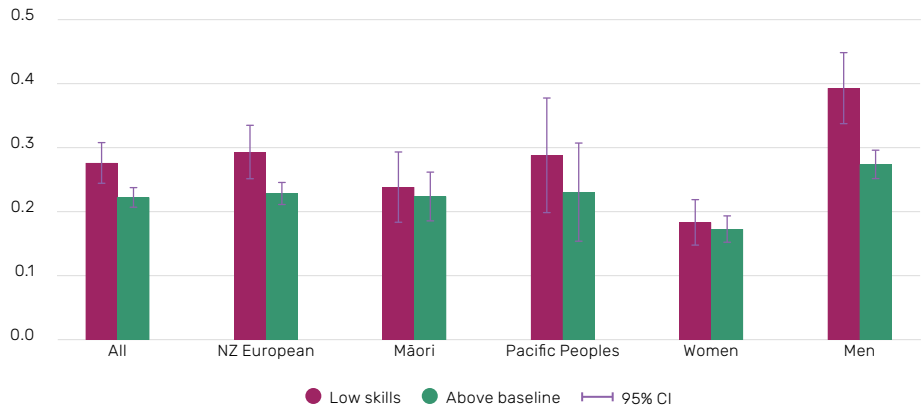
	(1) Low skills	(2) Above-baseline	(3) Difference	(4) p-value
Any injury	0.70	0.72	-0.02	0.224
Injuries at home	0.54	0.53	0.00	0.800
Road accidents	0.04	0.05	-0.00	0.757
Sport injuries	0.15	0.27	-0.13	0.000
Work injuries	0.28	0.22	0.05	0.005

Notes: This table compares the share of people with injuries for the group of people with low skills (column 1) and those with above baseline skills (2). Column 3 shows the difference between skill groups, column 4 shows the p-value testing the equality of the two means.

Figure 13 shows the share of people who have ever had a work injury by gender and ethnicity. As expected, men have higher rates of work injury than women, likely due to women working less hours on average (and therefore having lower exposure time to receive a work injury) and also being less likely to work in physical and dangerous roles. It may also reflect gender differences in risk preferences, particularly as women tend to have lower overall injury rates, not just work-related injury rates. Moreover, while those with low skills have higher work injury rates than those with above-baseline skills for both genders, the difference is much larger and statistically significant for men.

In terms of ethnicity, the work injury rates between 2015 and 2020 for Māori with both low skills and above-baseline skills is higher than their NZ European counterparts, although the differences are not statistically significant. This contrasts with Hennecke, Meehan, and Pacheco (2021), which finds that Māori and Pacific peoples have higher work-related injury rates than Europeans even after controlling for a range of individual and workplace characteristics. One explanation for the divergent results could be differences in the populations of interest. While Hennecke, Meehan, and Pacheco (2021) restrict the analysis to those who are employed in a given month, we consider work injuries for the entire population, including those who are not employed. Since Māori have a lower employment rate, this may also contribute to their lower work injury rate compared to Europeans.

Figure 13. Share of people with work injuries



Mental health

We now examine mental health outcomes. This is based on a combination of Ministry of Health information within the IDI following the method developed in Bowden *et al*. (2020). It combines information from pharmaceutical prescriptions, hospitalisations, mortality, and the Programme for the Integration of Mental Health Data (PRIMHD) data. We did not use data from disability support services (Socrates database) because of missing access, but this data source contributes less than 1 per cent of the identified mental health problems in Bowden *et al*. (2020).

In terms of caveats, as mentioned above, these data likely reflect a combination of the prevalence of mental health disorders and differences in the propensity to access health services across groups. With mental health, this is likely to be a larger issue than with physical health data, particularly among population groups where mental health disorders may be stigmatised, making it more difficult to seek medical treatment.

Figure 14 shows the share of people with mental health issues over time by age groups. There is no difference between the low-skills and above-baseline groups in the 36-45 year age group. For the 46-55 and 56-65 year age groups, a somewhat higher share of the low-skills group have had mental health issues, but these differences are not statistically significant. Across all three age groups, the share with mental health issues tend to increase over time as the groups age.

Figure 14. Share of people with mental health problems for different age groups

Figure 15 pools all observations and calculating adjusted means by skill level, gender and age. This more clearly shows that the share with mental health issues increases with age in general, although there is a dip in the share for men with low skills starting in about their mid-40s. Above-baseline men have the lowest rates of mental health issues, while women (both those in the above-baseline and low-skills groups) have the highest. However, the differences are generally not statistically significant.

Figure 15. Share of people with mental health problems by age for different skill groups

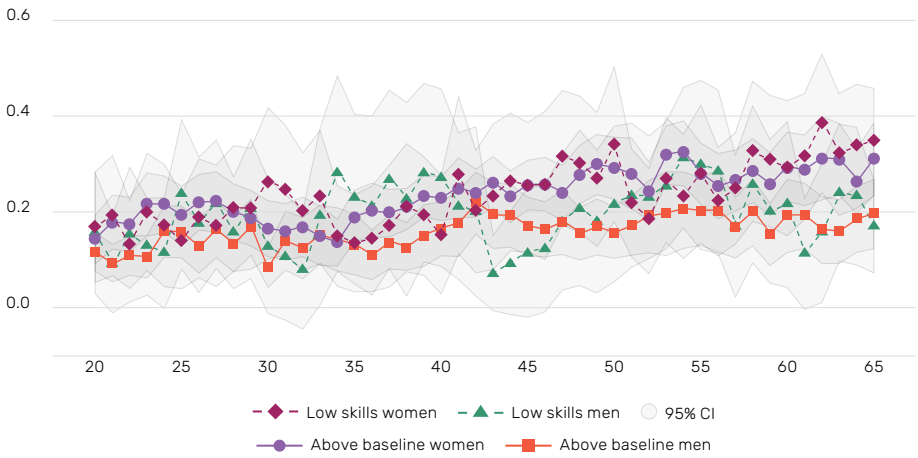


Table 6 examines whether an individual had any mental health issues over the 2015-2020 period. It further decomposes this into the type of issue experience. These results show no statistically difference in the overall rate of mental health problems between the low-skills and above-baseline groups. However, there are differences in the prevalence of the type of mental health issue. Consistent with Meehan, Pacheco, and Schober (2022b), those in the low-skills group are more likely to have substance abuse issues, while those in the above-baseline group are more likely to have sleep problems (significant at 10 per cent level).

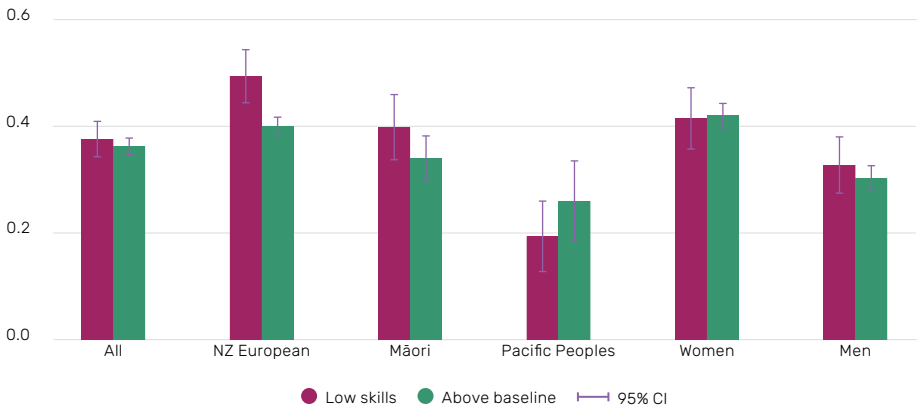
Table 6. Mental health disorders

	(1) Low skills	(2) Above-baseline	(3) Difference	(4) p-value
Any mental health problem	0.38	0.36	0.01	0.514
Emotional problems	0.17	0.16	0.01	0.413
Substance	0.08	0.03	0.05	0.000
Depression	0.12	0.11	0.01	0.454
Sleep problems	0.12	0.15	-0.03	0.058
Anxiety	0.08	0.08	0.00	0.807
Disruptive behaviours	0.01	0.00	0.00	0.756
Self-harm	0.01	0.01	0.00	0.305
Psychosis	0.02	0.01	0.01	0.018
Bipolar disorders	0.00	0.00	0.00	0.652
Eating problems	0.00	0.00	0.00	0.806
Personality disorders	0.00	0.00	-0.00	0.630

Notes: This table compares the share of people with mental health problems for the group of people with low skills (column 1) and those with above baseline skills (2). Column 3 shows the difference between skill groups, column 4 shows the p-value testing the equality of the two means.

Figure 16 shows the share of those who have ever had a mental health issue between 2015 and 2020 by gender and ethnicity. Women have higher rates of mental health issues than men. The difference is not statistically significant when comparing low skills men and women, but it is statistically significant when comparing above-baseline men and women. NZ Europeans have higher rates of mental health issues than Māori and Pacific peoples, although the differences between NZ Europeans and Māori are not statistically significant. Pacific peoples have the lowest rates of mental health issues. However, as speculated in Meehan, Pacheco, and Schober (2022b) this could be, at least in part, due to a lower propensity to seek medical treatment for mental health issues among Pacific peoples, particularly if it is generally more stigmatised among this population group. For example, Ministry of Health (2008) finds that Pacific peoples have a higher burden of mental disorder than New Zealanders in general, but that they are much less likely to access mental health services, and highlights that primary mental health care should include destigmatisation as a service component because of the way in which mental health issues are perceived by some Pacific communities.

Figure 16. Share of people ever having mental health problems



Crime

We next look at criminal activity outcomes. Figure 17 presents the share of individuals with alleged offences by age groups based on NZ Police offending records. As mentioned in Section 2.2 data are available for a shorter time period than some other outcomes investigated, such as employment and earnings. Across all three age groups examined, those with low skills have higher rates of alleged offending, although the differences are generally not statistically significant. Offending rates are higher among the younger group and lower among the older group, which is consistent with expectations as offending rates tend to be higher among younger people (Loeber and Farrington, 2014).

Figure 17. Share of people with offences for different age groups

Table 7 shows that the share of those with low skills who have ever been recorded as an alleged offender over the 2015-2020 period is 16 per cent compared with 6 per cent for those with above-baseline skills. These numbers appear quite high, particularly as they cover the shorter time period of 2015-2020, but this includes any type of offence, including low-level offences. In terms of the types of offences, the share of those in the low-skills group with offences against people, property and community are all higher than the share for the above-baseline group. Looking at the higher bar of convictions using Ministry of Justice data, about 9 per cent the low-skills group have been convicted of a crime, compared with 3 per cent of the above-baseline group. The shares are very similar to those of alleged offending, but the data for convictions also covers a longer time period. Those in the low-skills group are more likely to have received a fine, community work or supervision, home or community detention, and are more likely to have been imprisoned. Those with low skills are also more likely to have been victims of crime (18 per cent versus 13 per cent). This is consistent with a large literature that finds an overlap between those who are offenders and victims of crime (e.g. see Erwin, Hennecke, Meehan, and Pacheco, 2022, for NZ evidence).

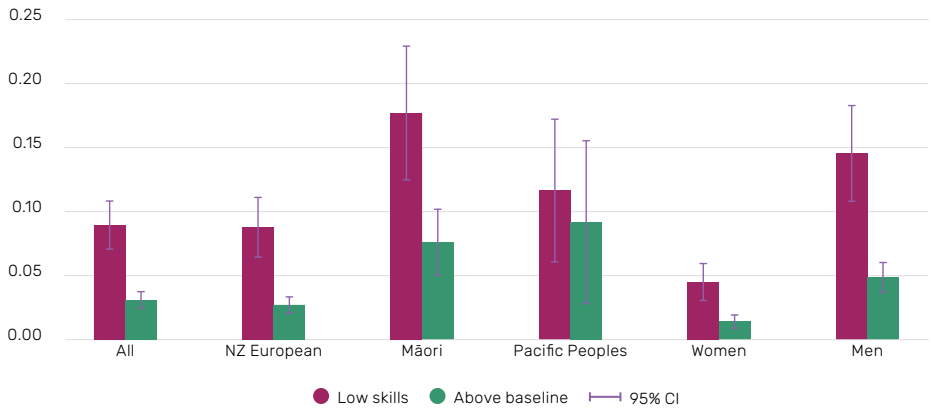
Table 7. Offending, court charges and victimisation

	(1) Low skills	(2) Above-baseline	(3) Difference	(4) p-value
Police recorded offence	0.16	0.06	0.10	0.000
Type of offences				
Offences against persons	0.09	0.03	0.06	0.000
Offences related to property	0.05	0.01	0.04	0.000
Offences against community	0.10	0.04	0.07	0.000
Conviction	0.09	0.03	0.06	0.000
Sentences				
Monetary	0.05	0.02	0.03	0.001
Community work / supervision	0.04	0.01	0.03	0.000
Home or community detention	0.02	0.00	0.02	0.001
Imprisonment	0.01	0.00	0.01	0.002
Victim of crime	0.18	0.13	0.05	0.003

Notes: This table compares average outcomes of students with low skills (column 1) and those with above baseline skills (2). Column 3 shows the difference between skill groups, column 4 shows the p-value testing the equality of the two means.

Figure 18 shows the share of people with convictions between 2015 and 2020 by gender and ethnicity. As expected, and consistent with aggregate crime statistics, men have much higher conviction rates than women. For both men and women, however, the conviction rate is higher among those with low skills. Looking across ethnic groups, a higher share of Māori have higher rates of convictions than NZ Europeans, which is consistent with NZ's population-level justice statistics (see, for example, Ministry of Justice, 2021). Within each ethnic group, the low-skills group has higher conviction rates, although the difference is not statistically significant for Pacific peoples. Interestingly, Māori with above-baseline skills have similar conviction rates as NZ Europeans with low skills.

Figure 18. Share of people with convictions



Different skill groups

In the analysis so far, we compare individuals with L+N skills below Level 2 in PIAAC to those with skills above this level, as the OECD uses this threshold to define populations with low proficiency (OECD, 2019a). Table 8 provides a sensitivity analysis by comparing our baseline results (which effectively compares the bottom fifth with the top four-fifths) to alternative definitions of low versus high performance for selected outcomes. Using proficiency scores in literacy and numeracy, we compare the top and bottom half, third, and quarter of respondents.

Looking at earnings, as expected, individuals in the bottom half of the L+N proficiency score distribution have higher average earnings than the low-skills group using the Level 2 definition (i.e. the bottom fifth). Likewise, the top half of the distribution have higher average earnings than the top four-fifth used in the Level 2 definition. Overall, this results in a slightly larger earnings gap between the low-skills and higher-skills group using the top and bottom half grouping than the Level 2 grouping (about $27,000 versus

$26,000). Comparing the top and bottom third and top and bottom quarter results in larger earnings gaps (approximately $37,000 and $44,000 respectively).

For the share receiving benefit payments, 44 per cent of those in the low-skills group based on the Level 2 definition received any benefit payment, compared with 19 per cent for the above-baseline group. In comparison, about a third of those in the bottom half of the skills distribution received any benefit payment, versus 14 per cent of those in the top half. This results in a smaller benefit-receipt gap overall (20 percentage points for the comparison of the top and bottom half versus 25 percentage points for the Level 2 definition). Comparing the top and bottom third and top and bottom quarter results in larger benefit-receipt gaps (28 and 32 percentage points respectively).

For the share with any hospitalisations, the comparison of the top and bottom half of the skills distribution yields the smallest gap (12 percentage points), followed by the Level 2 definition (13 percentage points), with the comparison of top and bottom quarter yielding the largest gap (20 percentage points). The gap in the workplace injury rate between the two groups is lowest among the Level 2 definition (5 percentage points) and largest among the top and bottom quarter comparison (13 percentage points).

Overall, while changing the definition of the comparison groups changes the relative magnitude of the differences in outcomes for the low-skills and higher-skills groups, the general patterns of differences remain.

Conclusion

This paper examines the life-course trajectories of NZ adults who participated PIAAC 2014 by using linked administrative data to track their outcomes from 2008 to 2020. PIAAC is a worldwide study administered by the OECD that assesses the literacy and numeracy proficiency of working-age adults (aged 16-65). This paper compared the outcomes of the approximately one-fifth of these adults who were assessed at below Level 2 in either literacy or numeracy (or both). We are able to follow these individuals over time, in the years both before and after PIAAC 2014, as PIAAC 2014 is linked to Stats NZ's IDI. This allows us to examine a range of outcomes using administrative data, such as education, labour market, health and criminal activity outcomes, using administrative data.

Table 8. Comparison of outcome for different skill groupings

	(1) Low performance	(2) High Low performance	(3) Difference	(4) p-value
Earnings				
Baseline results	35846.10	61753.94	-25907.83	0.000
Top and bottom half	42750.32	69798.45	-27048.12	0.000
Top and bottom third	39402.98	76651.67	-37248.69	0.000
Top and bottom quarter	37488.29	81144.41	-43656.12	0.000
Any benefit payments				
Baseline results	0.44	0.19	0.25	0.000
Top and bottom half	0.34	0.14	0.20	0.000
Top and bottom third	0.39	0.12	0.28	0.000
Top and bottom quarter	0.42	0.10	0.32	0.000
Any hospitalisation				
Baseline results	0.53	0.40	0.13	0.000
Top and bottom half	0.49	0.37	0.12	0.000
Top and bottom third	0.51	0.34	0.17	0.000
Top and bottom quarter	0.52	0.33	0.20	0.000
Work injury				
Baseline results	0.28	0.22	0.05	0.005
Top and bottom half	0.27	0.19	0.08	0.000
Top and bottom third	0.28	0.17	0.11	0.000
Top and bottom quarter	0.28	0.16	0.13	0.000

Notes: This table compares outcomes of those with low (Column 1) and high (2) performance for different skill groupings. Column 3 shows the difference between skill groups, Column 4 shows the p-value testing the equality of the two means. The number of observations is 5,559 for the baseline results and top versus bottom half, 3684 for top versus bottom third, and 2754 for top versus bottom quarter.

Adults with low L+N skills have lower average education levels. Based on PIAAC data, the average years of education for those with low skills is about two years lower than for those with above-baseline skills. Although IDI education data is incomplete for PIAAC adults since many would have completed their formal education before records begin, IDI enrolment data shows that those in the low-skills group are less likely to have enrolled in tertiary education at some point, with a particularly large difference in the share who have ever enrolled in a bachelor's degree (8 per cent versus 23 per cent).

The labour market outcomes of the low-skills group are also less favourable than those of the above-baseline group, with the results differing by gender. The employment rates of men in the low-skills and above-baseline groups are reasonably similar, while

those of women with low skills are lower than above-baseline women. Men with above-baseline skills have the highest average earnings of all the groups. Women with above-baseline skills do not experience the same earnings growth in their 30s as men, but their earnings do not decrease as quickly in their late working years. Women with low skills have the lowest average earnings. In terms of ethnicity, for the low-skills group, there is no statistically significant difference between the average observed earnings of NZ Europeans and Pacific peoples, while Māori have the lowest average earnings. For the above-baseline group, NZ Europeans have higher average earnings than Māori and Pacific peoples. Māori and Pacific peoples are also more likely to have received a main benefit for both the low-skills and above-baseline groups.

Those with low skills also have higher hospitalisation rates, with about 53 per cent having been hospitalised at some point over the period examined, versus 40 per cent of the above-baseline group. However, there is no statistically significant difference in injury rates, reflecting that work injury rates are higher among the low-skills group but sports injury rates are lower. There is also no statistically significant difference in mental health disorders overall, but those in the low-skills group are more likely to have substance abuse issues while those in the above-baseline group are more likely to have emotional, sleep problems.

In terms of criminal activity outcomes, those with low skills are more likely to have been an alleged offender and to have at least one conviction. As expected, a much higher share of men have convictions compared with women for both the low-skills and above-baseline groups. Also consistent with population-level justice statistics, a much higher share of Māori have convictions than NZ Europeans, with the share of Māori with above-baseline skills who have convictions being similar to the share of NZ Europeans with low skills.

Overall, the results are consistent with international research that highlights how low L+N skills may affect an individual's wellbeing, including via educational, labour market, health and justice outcomes. These results are also similar to those of Meehan, Pacheco, and Schober (2023) and Meehan, Pacheco, and Schober (2022b), which follows the outcomes of young people with low skills versus those with above-baseline skills from the age of 15 to 26. This suggests that these educational, earnings, health and justice outcomes that appear early in life do not dissipate. While it is difficult to make direct comparisons because some of the effects may be due to cohort differences, combining the results of this paper with these earlier papers suggests that differences between the low-skills and above-baseline groups may increase over time, at least on some dimensions. This widening disparity gap, for example, is particularly evident for labour market outcomes, with earnings gaps between those with low and above-baseline skills increasing as individuals enter their prime and late earning years.

Disclaimer

Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the author, not Stats NZ or individual data suppliers. These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) which is carefully managed by Stats NZ. For more information about the IDI please visit https://www.stats.govt.nz/integrated-data/.

The results are based in part on tax data supplied by Inland Revenue to Stats NZ under the Tax Administration Act 1994 for statistical purposes. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.

Competing interests

None to declare.

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A. Additional tables

Table 9. Definition of outcome variables (1)

Outcome	Description
Education enrolment	
Tertiary education	Enrolled in any tertiary education (Source: MoE tertiary qualification enrolment).
Bachelor	Enrolled in bachelor type tertiary education (MoE tertiary qualification enrolments).
Industry training	Indicator for workplace-based training (MoE industry training data).
Targeted training	Enrolled in targeted training programmes (Gateway, Skill Enhancement, Training Opportunities, Foundation Focused Training Opportunities Youth Training; MoE targeted training data).
Any schooling or training	Enrolled in compulsory education, tertiary education, industry training, or targeted training (MoE enrolment data).
Educational attainment	
Years of education	Years of formal education obtained (PIAAC).
Any post-school qualification	Whether post-school or tertiary qualification obtained (PIAAC).
Income and employment	
Earnings	Sum of wages, salaries and income from self-employment based on tax data in 2020 prices using the consumer price index (Inland Revenue (IR) derived income data).
Employed	Indicator for having any earnings (IR).
Occupations	Working in an occupation classified according to 1-digit ISCO 2008 level (PIAAC).
Benefit payments	Sum of benefit payments from the Ministry of Social Development (IR derived income data).

Table 10. Definition of outcome variables (2)

Outcome	Description
Health	
Any injuries	Indicator for injuries after accidents (Source: Accident compensation corporation (ACC) injury claims).
Injuries at home	Accidents that occurred at home (ACC).
Work injuries	Paid from ACC work account or claim occurred at place of work (ACC).
Road accidents	Paid from ACC motor vehicle account (ACC).
Sport injuries	Engaged in recreation/sporting activity at the time of the accident (ACC).
Mental health problems (emotional problems, substance, depression, sleep problems, anxiety, disruptive behaviours, self-harm, psychosis, bipolar disorders, eating problems, personality disorders)	Indicators for mental health problems using various data sources in the IDI following Bowden et al. (2020), including pharmaceutical prescriptions, hospitalisations, death causes, and the Programme for the Integration of Mental Health Data (PRIMHD).We did not use data from disability support services (Socrates database) because of missing access, but this data source contributes less than 1% of the identified mental health problems in Bowden *et al.* (2020).
Hospitalisation	Indicator for publicly funded hospital events (Source: Ministry of Health (MoH) national minimum dataset).
Hosp. excluding childbirth	Hospitalisation excluding Major Diagnostic Categories (MDC) 14 and 15.
Hospital Diagnoses	
Musculoskeletal system	Hospitalisation for MDC 8.
Ear, nose, mouth and throat	Hospitalisation for MDC 3.
Digestive system	Hospitalisation for MDC 6.
Injuries	Hospitalisation for MDC 21.
Nervous system	Hospitalisation for MDC 1.
Skin, subcutaneous tissue and breast	Hospitalisation for MDC 9.
Non-admitted secondary care events	Indicator for any non-admitted secondary care event (MoH National Non-Admitted Patient Collection (NNPAC)).
Emergency department visits	Emergency department event types (NNPAC)
Other outpatient visits	Outpatient and community referred events (NNPAC).
Crime	
Police recorded offence	Being proceeded against by the police. (Source: NZ Police recorded crime offenders data.)
Offences against persons	Divisions 1-6 of the Australian and New Zealand Standard Offence Classification (ANZSOC, Australian Bureau of Statistics, 2011), capturing acts that result in harm and affect a specific person (Police).
Offences related to property	Divisions 6-9 and 12 of ANZSOC such as robbery and theft (Police).
Offences against community	Divisions 10, 11, 13-16 of ANZSOC include offences against organisations, government and community (Police).
Conviction	Convicted by a court (Ministry of Justice (MoJ) criminal court charges).
Court sentences (monetary, community work or supervision, home or community detention, imprisonment)	Having the respective court sentence. Note that the data only records the five most serious sentences per charge (MoJ).
Victim of crime	Being recorded as crime victim. (Source: NZ Police victimisations).