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Literacy achievement between women and men according to the Program for the International Assessment of Adult Competencies

Logros de alfabetización entre mujeres y hombres de acuerdo con el Programa de Evaluación Internacional de Competencias de Adultos

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Abstract

The literacy of a country is key to the development of society. This work aims to find out if there are differences between the reading abilities of men and women between the ages of 16 and 24 compared to other older age groups, and if this behavior is consistent among the 22 countries that carried out the Program for the International Assessment of Adult Competencies test. The *intsvy* library was used in the *R* and *RStudio* software, and the linear regression function. The results do not show significant differences between the scores of men and women. However, there are significant differences between different age groups and countries. People between the ages of 25 and 34 tend to have higher literacy scores than the rest of the countries.

Keywords: literacy, PIAAC, women education, international education

Resumen

La alfabetización de un país es clave para el desarrollo de la sociedad. Este trabajo pretende averiguar si existen diferencias entre las habilidades lectoras de hombres y mujeres entre 16 y 24 años en comparación con otros grupos de mayor edad y si este comportamiento es constante entre los 22 países que realizaron la prueba Programa de Evaluación Internacional de Competencias de Adultos. Se utilizó la librería *intsvy* en el software *R* y *RStudio* y la función de regresión lineal. Los resultados no muestran diferencias significativas entre las puntuaciones entre hombres y mujeres. Sin embargo, existen diferencias significativas entre los distintos grupos de edad y países. Las personas entre 25 y 34 años tienden a tener puntajes de alfabetización más altos que el resto de los países.

Palabras clave: alfabetización, PIAAC, educación de las mujeres, educación internacional

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1. Introduction

Literacy is the human ability to learn, understand, evaluate, and use texts that allow them to develop in society (OECD, 2013; Rampey et al., 2016; Trawick, 2019). Understanding a text implies knowing its words (McKoon & Ratcliff, 2018). Literacy is measured by understanding the text and mastering the vocabulary (Rampey et al., 2016) through different processes that allow them to measure their ability to identify words, infer, and memorize, among others (Engelhardt et al., 2021). These skills allow them to develop in society in their daily life at home and school or in professional activities (Perry et al. 2020) Literacy is understood in a complex, multidimensional way, within the framework of learning for life.

1.1. Differences in reading skills by age

Previous studies have focused on analyzing the reading comprehension skills of the child population. However, there are not many studies about how the community of university age or adults behaves. Reading is a relevant skill during university because of the large number of texts that must be read to obtain knowledge. Besides, not having this ability makes it difficult for adults to develop in society and in the workplace (Brizuela Rodríguez et al., 2020).

Some hypotheses mention that age is essential for text comprehension since older people may have problems remembering things in the short term, process information more slowly, or lose the ability to identify relevant information (Flisi et al., 2019; McKoon & Ratcliff, 2018). Calero et al. (2019) have researched Program for the International Assessment of Adult Competencies (PIAAC) data and found that literacy skills increase until they reach the age of 30 and decline significantly after that, with information from 16 countries.

1.2. Differences in reading skills by gender

According to the Programme for International Student Assessment (PISA) 2018 results, girls have better reading strategies than boys (Suárez-Álvarez et al., 2022).Moreover, in some countries, it has been observed that girls learn more than boys, even if they attend to the same classes (Kaffenberger & Pritchett, 2020). In developed countries, both genders have shown similar cognitive abilities. However, in developing countries, women tend to have a disadvantage because they get lower grades (Angrisani, Lee, & Meijer, 2020).

In recent years, the number of women who have achieved university education and have established themselves in jobs similar to men has increased (Moreno Treviño & Valenzuela Sánchez, 2021). Women are interested in receiving a higher level of education that allows them to be independent or help more with household economic issues (Almelhem et al., 2022).

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1.3. Program for the International Assessment of Adult Competencies

In 2013, the first round of the Program for the International Assessment of Adult Competencies (PIAAC) was held, with the participation of 24 countries. The second round was held with 35 countries, and more than 30 countries have agreed to participate in another round of the evaluation in the 2022-2023. Within PIAAC, three aspects are evaluated:literacy, numeracy, and problem solving in technology (Boeren & Íñiguez-Berrozpe, 2022; Hamilton, 2018). The study was answered by people between 15 and 65 years old and collected information about their country, gender, and more (Boeren & Íñiguez-Berrozpe, 2022).

Some results obtained with the PIAAC have shown that in Greece, women obtained better results than men. In New Zealand, neither age nor gender influenced the results. In Singapore, younger adults have better outcomes than older adults (Hamilton, 2018). The general results for the United States report better literacy results in men and women between 25 and 44 than the rest of the age ranges (Rampey et al., 2016) and that their general literacy averages are not significantly different from those of the rest of the countries (Trawick, 2019).

1.4. Aim and hypotheses

The present investigation aims to identify if there is a difference between the reading scores of men and women between 16 and 24 years old, which is usually college age in most countries, with the data collected in the PIACC study of 22 countries. Thus, the following hypotheses are proposed:

Hypothesis 1: Women present better literacy scores than men in the PIAAC test.

Hypothesis 2: People between 16 and 24 years old have better literacy scores than older people in the PIAAC test.

Hypothesis 3: All countries behave similarly regarding literacy scores from the PIAAC test.

Even though the data is freely accessible, not much research has been carried out to analyze how these variables are related to this specific sample. The aim is to focus on women between the ages of 16 and 24 as a point of comparison against men and other age ranges, since this is where most university students would enter.

2. Research method

PIAAC has 150,903 responses from 22 countries. The results are divided by gender, age and country. The Table 1 shows the variables used for this investigation, the column in which they are found in the database and the possible answers they may have.

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Table 1
Variables, columns and possible answers were used from the PIAAC test

Variable	Column in the database	Possible answers
Country	CNTRYID	Austria, Belgium, Canada, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Ireland, Italy, Japan, Korea, Netherlands, Norway, Poland, Russian Federation, Slovak Republic, Sweden, United States.
Age	AGEG10LFS	24 or less, 25-34, 35-44, 45-54, 55 or plus.
Gender	GENDER R	Female, Male.

Literacy at PIAAC is scored with the ability to read directions, instructions, letters, memos, emails, newspapers, magazines, newsletters, professional journals, academic journals, books, manuals, reference materials, receipts, invoices, bank statements, financial statements, diagrams, maps or schematics. Besides, the ability to write letters, memos, emails, articles for newspapers, magazines, newsletters, reports and fill out forms (Hamilton, 2018). The results were obtained with the *intsvy* library in the *R* program and *RStudio* version 4.2.0 (Caro & Biecek, 2017; R Core Team, 2022; RStudio Team, 2022).

The piaac.mean.pv function was used to display the results of frequency, means of plausible values, standard error and variance, and their standard error of the responses of men and women by age and country (Caro & Biecek, 2017). Using *Excel*, the frequency table was adjusted for better organization by age.

Plausible values are multiple imputed proficiency values based on information from the literacy test items and information provided by the respondent (OECD, 2013). Within the PIAAC scale, plausible values are weighted from 0 to 500, which allows the results to be standardized and compared between different countries (Cathles et al., 2021). The Table 2 shows the equations used by the program to obtain the results (Caro & Biecek, 2017).

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Table 2
Equations used by PIAAC

Name	Equation	Values
Average of plausible values	$\theta = \frac{1}{M}\sum_{i=1}^{M}\theta_i$	M = number of imputations,
Imputation variance	$VAR_{imp}[\theta] = \frac{1}{M-1}\sum_{i=1}^{M}(\theta_i - \theta)^2$	θ_i = average score for plausible value,
Sampling variance	$VAR_{sml}[\theta] = c\sum_{j=1}^{R}(\theta_i - \theta)^2$	M , θ = average estimate of student performance, R = number of replicate weights,
Total variance	$VAR_{tot}[\theta] = VAR_{sml}[\theta] + (1 + \frac{1}{M})VAR_{imp}[\theta]$	c = $\frac{G-1}{G}$ for Austria, Canada Denmark and Germany while
Standard error	$SE[\theta] = \sqrt{VAR_{tot}[\theta]}$	c = 1 for other countries.

The linear model is related to a linear predictor through the function in equation 1.

$$E(Y|\, X = x) = \beta_1 + \beta_2 x_i \qquad (1)$$

where E is the conditional mean of Y given X = x, β_1 is the coefficient pointing to the origin and β_2 is the slope coefficient and x_i is the gender, age, country or the sum of them i (Evans & Rosenthal, 2005).

The piaac.reg.pv function returns the results of the linear regression analysis (OLS) with the plausible values and replicates weights to see the coefficients, standard errors, *t* values, and *R-squared* for each country. Moreover, it is possible to obtain graphs summarizing the model coefficients and their standard errors (Caro & Biecek, 2017). Then it was possible to obtain the plots by gender and age, coefficients of the results of women and coefficients by age.

3. Results and discussion

According to the PIAAC data, the most significant participation is observed in Canada (N=26683), Poland (N=9366) and the United Kingdom (N=8892). The countries with the fewest responses were Italy (N=4,621), Sweden (N=4,469), and Russia (N=3,892). The Table 3 shows the frequencies of the participants by country, gender, and age.

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Table 3

Frequencies of the responses were classified by country, gender and age range

Country	Gender	24 or less	25-34	35-44	45-54	55 or plus	Total
Austria	Male	445	469	549	567	449	2,479
	Female	447	468	546	599	486	2,546
Belgium	Male	469	409	483	587	519	2,467
	Female	462	456	511	569	519	2,517
Canada	Male	2,322	1,994	2,398	2,911	2,817	12,442
	Female	2,298	2,580	2,963	3,312	3,088	14,241
Czech Republic	Male	739	582	448	379	608	2,756
	Female	739	756	585	454	791	3325
Germany	Male	533	486	542	625	455	2,641
	Female	530	493	558	670	487	2,738
Denmark	Male	543	490	632	724	1,201	3,590
	Female	521	538	722	722	1193	3696
Spain	Male	505	567	733	616	508	2,929
	Female	486	604	719	677	556	3,042
Estonia	Male	665	674	700	688	705	3,432
	Female	681	745	858	856	1,014	4,154
Finland	Male	455	533	498	566	705	2,757
	Female	440	511	473	557	726	2,707
France	Male	539	569	673	768	833	3,382
	Female	556	636	730	754	849	3,525
United Kingdom	Male	521	733	802	828	809	3,693
	Female	698	1,109	1,218	1,042	1,046	5,113
Ireland	Male	354	616	737	525	496	2,728
	Female	399	777	872	575	612	3,235
Italy	Male	275	380	600	495	470	2,220
	Female	249	404	629	526	561	2,369
Japan	Male	400	433	549	467	619	2,468
	Female	370	485	670	545	635	2,705

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Table 3
Frequencies of the responses were classified by country, gender and age range

Country	Gender	24 or less	25-34	35-44	45-54	55 or plus	Total
Korea	Male	467	630	687	730	578	3,092
	Female	599	628	843	814	675	3,559
Netherlands	Male	454	364	492	560	631	2,501
	Female	433	425	537	621	565	2,581
Norway	Male	492	469	530	567	499	2,557
	Female	472	451	542	489	436	2,390
Poland	Male	2,355	1,027	398	449	504	4,733
	Female	2,118	1,074	437	433	571	4,633
Russian Federation	Male	493	315	175	191	170	1,344
	Female	744	515	400	408	480	2,547
Slovak Republic	Male	550	604	505	527	511	2,697
	Female	585	616	559	592	653	3,005
Sweden	Male	409	407	455	450	532	2,253
	Female	433	396	411	476	500	2,216
United States	Male	412	457	441	496	455	2,261
	Female	401	570	514	563	589	2,637
Total		29,058	28,445	30,324	30,970	32,106	150,903

There were 150,903 responses, 79,481 from women and 71,422 from men from 22 countries. Of which 29,059 were 24 years old or younger, 28,445 were between 25 and 34 years old, 30,324 were between 35 and 44 years old, 30,970 were between 45 and 54 years old and 32,106 were 55 or older.

The averages with plausible values, the standard error, standard deviation and the standard error of the literacy scores were obtained. In the Table 4 the results of the women between 16 and 24 years old are shown, where it is observed that the highest qualifications were obtained by Japan (μ = 297.47), Finland (μ = 297.13), Netherlands (μ = 295.21), Korea (μ = 292.43) and Estonia (μ = 290.24). Those with the lowest results are the United States (μ = 273.36), Ireland (μ = 270.03), and Italy (μ = 265.28). United Kingdom (μ = 263.77) and Spain (μ = 263.03).

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Table 4

Mean and standard deviation with their standard error of literature scores of women ages 16-24 by country

Country	Mean	s.e.	SD	s.e.
Austria	277.43	2.09	41.26	1.89
Belgium	286.29	2.34	39.05	1.83
Canada	276.39	1.71	43.95	1.54
Czech Republic	278.36	3.07	38.23	2.10
Germany	276.91	1.91	45.27	1.56
Denmark	278.62	1.77	39.68	1.85
Spain	263.03	2.03	41.29	1.75
Estonia	290.24	1.54	38.87	1.33
Finland	297.13	2.36	43.66	2.59
France	276.59	1.56	40.31	1.48
United Kingdom	263.77	2.92	47.14	2.82
Ireland	270.03	2.52	40.17	2.28
Italy	265.28	3.05	35.80	2.41
Japan	297.47	2.33	35.38	1.72
Korea	292.43	1.92	31.38	1.53
Netherlands	295.21	2.33	40.65	2.19
Norway	274.78	1.92	42.37	2.10
Poland	284.23	1.38	39.37	1.03
Russian Federation	278.34	4.31	39.84	2.12
Slovak Republic	276.64	1.96	38.36	1.60
Sweden	282.65	2.60	47.14	3.61
United States	273.36	3.00	39.13	1.88

The Table 5 shows the results of men between 16 and 24 years old, where the countries with the highest scores were Japan (μ = 301.13), Finland (μ = 297.28), Netherlands (μ = 294.05), Korea (μ = 293.53) and Estonia (μ = 284.03). Those with the lowest results are the United States (μ = 269.96), Russia (μ = 269.91), and the United Kingdom (μ = 267.57). Spain (μ = 264.68) and Italy (μ = 257.26).

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Table 5
Mean and standard deviation with their standard error of literature scores of men ages 16-24 by country

Country	Mean	s.e.	SD	s.e.
Austria	277.98	2.30	44.48	2.45
Belgium	283.75	2.08	43.85	1.68
Canada	275.03	1.70	46.38	1.65
Czech Republic	282.63	2.49	40.53	2.11
Germany	280.91	2.47	43.72	2.18
Denmark	273.58	2.13	43.49	1.75
Spain	264.68	2.18	42.85	1.78
Estonia	284.03	1.99	41.60	1.49
Finland	296.28	2.59	42.69	2.29
France	273.44	1.83	44.76	1.37
United Kingdom	267.57	3.56	45.97	2.34
Ireland	271.15	2.72	41.89	2.37
Italy	257.26	3.96	48.26	3.57
Japan	301.13	2.05	34.86	1.67
Korea	293.53	2.22	35.30	2.04
Netherlands	294.05	2.26	41.86	1.66
Norway	275.28	2.05	44.37	1.92
Poland	278.87	1.40	43.39	1.20
Russian Federation	269.91	4.58	43.76	2.26
Slovak Republic	275.39	2.33	40.71	1.73
Sweden	282.87	2.23	44.37	2.09
United States	269.96	2.84	45.57	2.05

After the comparison, the results of both genders shows that the order of the countries with the highest scores is the same. The difference is that in Japan and Korea the average for men is higher than for women, which is not the case in Finland, the Netherlands and Estonia where the average for women is slightly higher.

In the countries with lower averages, there is a more significant variation in the order, but they are still almost the same, except for Ireland in the case of women and Russia in the case of men. However, the United States, the United Kingdom, Spain, and Italy consistently have the lowest literacy rates. When performing the linear regression model, gender is not a significant variable ($P > 0.05$), but some countries and age ranges are.

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The results show that in some countries there are differences between genders, which shows that literacy levels vary according to gender and country. Therefore, statistically, there are no differences between the literacy scores between men and women according to the PIAAC test.

The countries which have similar behavior are Austria, Canada, the Czech Republic, Denmark, Germany, Ireland, Korea, Poland, the Slovak Republic, the United Kingdom and the United States with p−values greater than 0.05. Estonia, France and Russia have a p−value less than 0.05. Belgium and Norway have a p−value less than 0.01. Finland, Italy, the Netherlands, Spain and Sweden have a p-value less than 0.001.

Regarding the age of the participants, those between 25 and 34 ($P < 0.001$), between 45 and 54 ($P < 0.001$) and 55 years or older ($P < 0.001$) present a different behavior. These results can be seen in the Table 6 where the linear model data is found.

Table 6

Results of the linear model when considering gender, age and country

Country	Estimate	s.e.	t value	Pr(> |*t*|)	
(Intercept)	275.2632	2.0611	133.550	< 2e-16	***
Belgium	7.3340	2.6312	2.787	0.005845	**
Canada	4.0150	2.6312	1.526	0.128661	
Czech Republic	4.4420	2.6312	1.688	0.092983	.
Germany	1.7990	2.6312	0.684	0.494967	
Denmark	6.3510	2.6312	2.414	0.016723	*
Spain	19.9650	2.6312	7.588	1.35e-12	***
Estonia	-6.5630	2.6312	-2.494	0.013459	*
Finland	0.9150	2.6312	0.348	0.728403	
France	-4.1960	2.6312	-1.595	0.112408	
United Kingdom	-18.3630	2.6312	-6.979	4.64e-11	***
Ireland	27.5520	2.6312	10.471	< 2e-16	***
Italy	2.9270	2.6312	1.112	0.267334	
Japan	15.2920	2.6312	5.812	2.52e-08	***
Korea	8.5350	2.6312	3.244	0.001390	**
Netherlands	-2.6900	2.6312	-1.022	0.307889	
Norway	5.6580	2.6312	2.150	0.032769	*

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Table 6

Results of the linear model when considering gender, age and country

Country	Estimate	s.e.	t value	Pr(> |*t*|)	
Poland	4.0920	2.6312	1.555	0.121535	
Russian Federation	-17.3450	2.6312	-6.592	4.04e-10	***
Slovak Republic	10.0470	2.6312	3.818	0.000181	***
Sweden	2.5140	2.6312	0.955	0.340534	
United States	0.2500	2.6312	0.095	0.924401	
Male	1.2645	0.7933	1.594	0.112602	
Age 25-34	4.2859	1.2544	3.417	0.000773	***
Age 35-44	0.7805	1.2544	-0.622	0.534548	
Age 45-54	11.3366	1.2544	-9.038	< 2e-16	***
Age 55 plus	-23.4609	1.2544	-18.704	< 2e-16	***

People between 25 and 34 years old are more likely to obtain higher literacy scores, it is possible to see that the scores are reduced after that age. The results are consistent with the investigation made by Flisi et. al (2019), who found that literacy skills decrease significantly with age in the countries investigated when they compared ten countries using data from the International Adult Literacy Survey (IALS) of 1994–1998 and PIAAC. Besides, McKoon and Ratcliff (2018) mention that reading skills deteriorate with age since older people may be slower to respond than university students.

The people who tend to have a higher average in literacy scores are 25-34 years old, followed by 35-44 and then 24 or less. In all cases, the groups aged 55 or plus are the ones with the lowest average. This behavior is similar in both genders in different countries, but there are some exceptions to these behaviors.

For example, the population of the Czech Republic, Germany, France, Spain, men in Estonia and Italy, and women in the Netherlands aged 24 and under have averages very close to those of adults aged 25 to 34 in their country. In Korea and Poland, people under 25 years of age have higher averages than those between 25 and 34 years of age in the PIAAC literacy scores, as do women in Estonia, the United States, Austria, and Italy.

Women in Belgium, Denmark, and Ireland and men in Austria and Spain aged 24 and under have similar averages to those aged 35-44. Finnish men under 25 have higher averages than those between 35 and 44 years of age. In Norway, women aged 24 and under have an average close to those between 44 and 55 years old, while men of the same age have an average lower than those between 44 and 55 years old.

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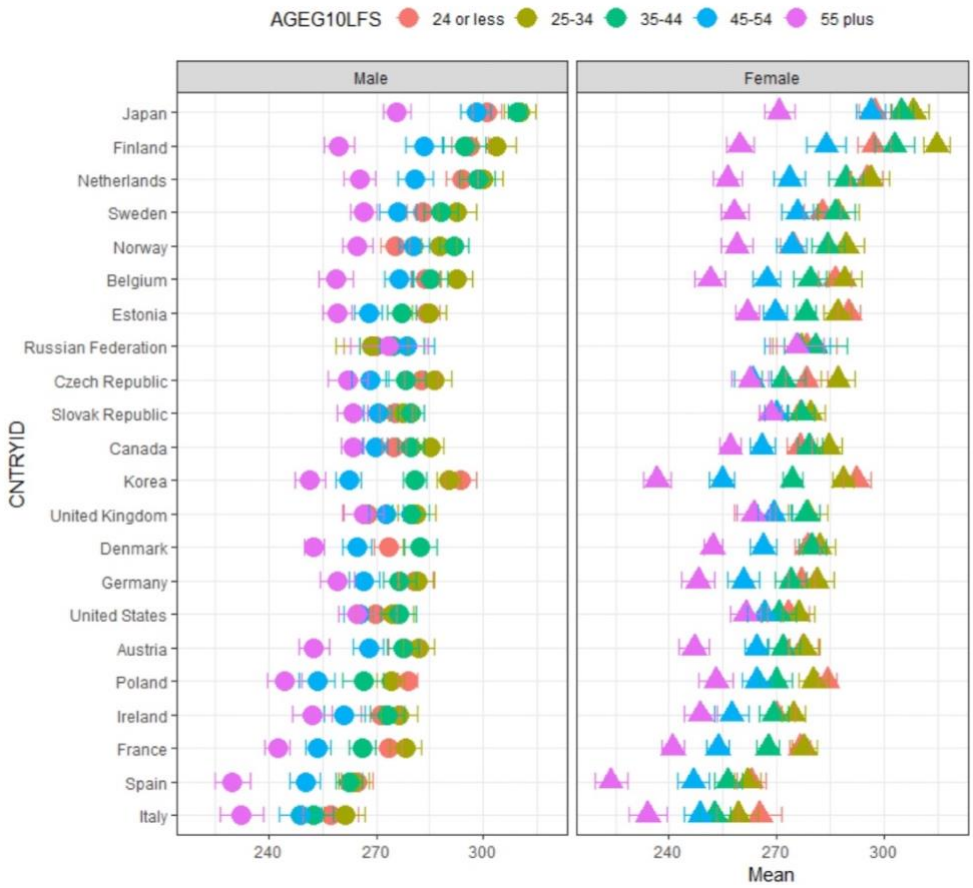
People in Denmark and women in Sweden between the ages of 25 and 34 have a similar average to those between the ages of 35 and 44. The mean of 35-44 in the United States is higher than that of 25-34. Russia behaves very differently from the rest of the countries; all age groups have a similar average. These differences and similarities can be seen more clearly in Figure 1.

Figure 1

Summary of averages by age groups between men and women of 22 countries with their standard error



McKoon & Ratcliff (2018) mention that the reading skills of older adults are lower than those of university students, in this case, considered those under 25 years old. Calero et al. (2019) had already found that with the PIAAC data, the adults with the best grades are those in the range of 25 to 34 years old and that afterward, there is usually a decrease in reading skills, although only used data from 16 countries.

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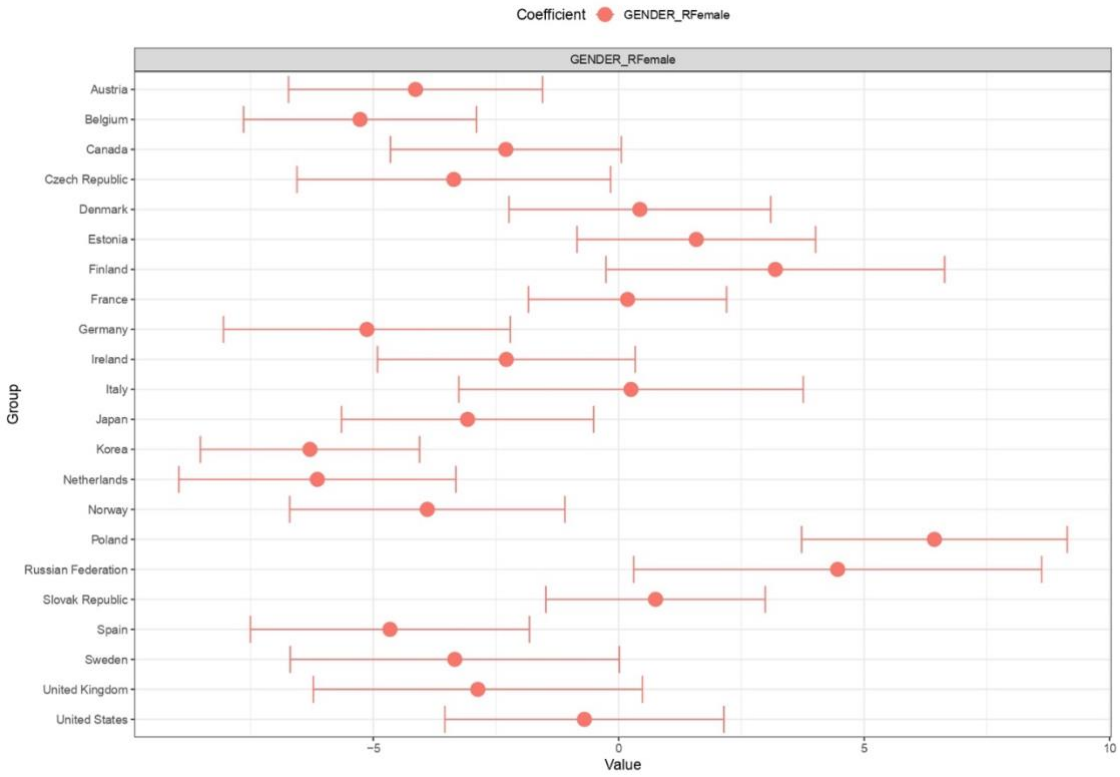
The women's coefficients show different behaviors between countries. The countries where men have a higher literacy score are Belgium, Germany, Korea and the Netherlands. On the other hand, in Poland and Russia, women have, on average, better scores than men.

Some of the most outstanding are Finland (P = 1.35e-12), Italy (P = 4.64e-11), Japan (P < 2e-16), Netherlands (P = 2.52e-08), Spain (P = 4.04e-10), Sweden (P = 10.047), Those aged 25 to 34 years (P = 0.000773), 45 to 54 years (P < 2e-16) and those over 55 (P < 2e-16. However, as mentioned above, the differences between the two genders are insignificant. Figure 2 shows the coefficients of the results of women of all ages, with their average and variation.

Figure 2

Coefficients of the results of women of the 22 countries



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In this case, no differences are observed between the literacy skills of men and women. Other studies have found that women tend to have better results when other databases such as PISA are used, where it has been found that girls end to have better results than boys (Suárez-Álvarez et al., 2022).

The linear model has performed again without considering gender, only country and age ranges. It was found that several countries have a significant value and several age ranges, as in the first case. However, no significant difference is observed between the two results of the model in Table 7.

Table 7

Results of the linear model when considering age and country

Country	Estimate	s.e.	t value	Pr(> |*t*|)	
(Intercept)	275.8954	2.0306	135.869	< 2e-16	***
Belgium	7.3340	2.6416	2.776	0.006036	**
Canada	4.0150	2.6416	1.520	0.130159	
Czech Republic	4.4420	2.6416	1.682	0.094262	.
Germany	0.9150	2.6416	0.346	0.729430	
Denmark	1.7990	2.6416	0.681	0.496664	
Spain	-17.3450	2.6416	-6.566	4.61E-10	***
Estonia	6.3510	2.6416	2.404	0.017147	*
Finland	19.9650	2.6416	7.558	1.58E-12	***
France	-6.5630	2.6416	-2.484	0.013820	*
United Kingdom	2.5140	2.6416	0.952	0.342433	
Ireland	-4.1960	2.6416	-1.588	0.113815	
Italy	-18.3630	2.6416	-6.952	5.36E-11	***
Japan	27.5520	2.6416	10.430	< 2e-16	***
Korea	2.9270	2.6416	1.108	0.269214	
Netherlands	15.2920	2.6416	5.789	2.81E-08	***
Norway	8.5350	2.6416	3.231	0.001449	**
Poland	-2.6900	2.6416	-1.018	0.309791	
Russian Federation	5.6580	2.6416	2.142	0.033449	*
Slovak Republic	4.0920	2.6416	1.549	0.122995	
Sweden	10.0470	2.6416	3.803	0.000191	***

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Table 7

Results of the linear model when considering age and country

Country	Estimate	s.e.	t value	Pr(> |t|)	
United States	0.2500	2.6416	0.095	0.924698	
Age 25-34	4.2859	1.2593	3.403	0.000809	***
Age 35-44	-0.7805	1.2593	-0.620	0.536157	
Age 45-54	-11.3366	1.2593	-9.002	< 2e-16	***
Age 55 plus	-23.4609	1.2593	-18.630	< 2e-16	***

After analyzing the second linear model, it is possible to see that Denmark, the United Kingdom, Ireland, Korea and the Slovak Republic do not have p-values less than 0.05. That is, without gender, there are no longer significant influences when living in these countries. Contrary to Finland, France, Italy, the Netherlands, and Sweden, whereby not include gender, it is observed that the results are significant.

When comparing the results of the age ranges, they continue to behave in the same way in both models. The results of the coefficients of people between 25 and 34 years old indicate that most countries have a higher average than 24 or less, except for Korea and Poland, where the opposite is the case.

In the Figure 3, the study participants are divided by country and age, between the ages of 25-34, 35-44, 45-54 and 55 or more in all the countries, with the linear regression coefficients.

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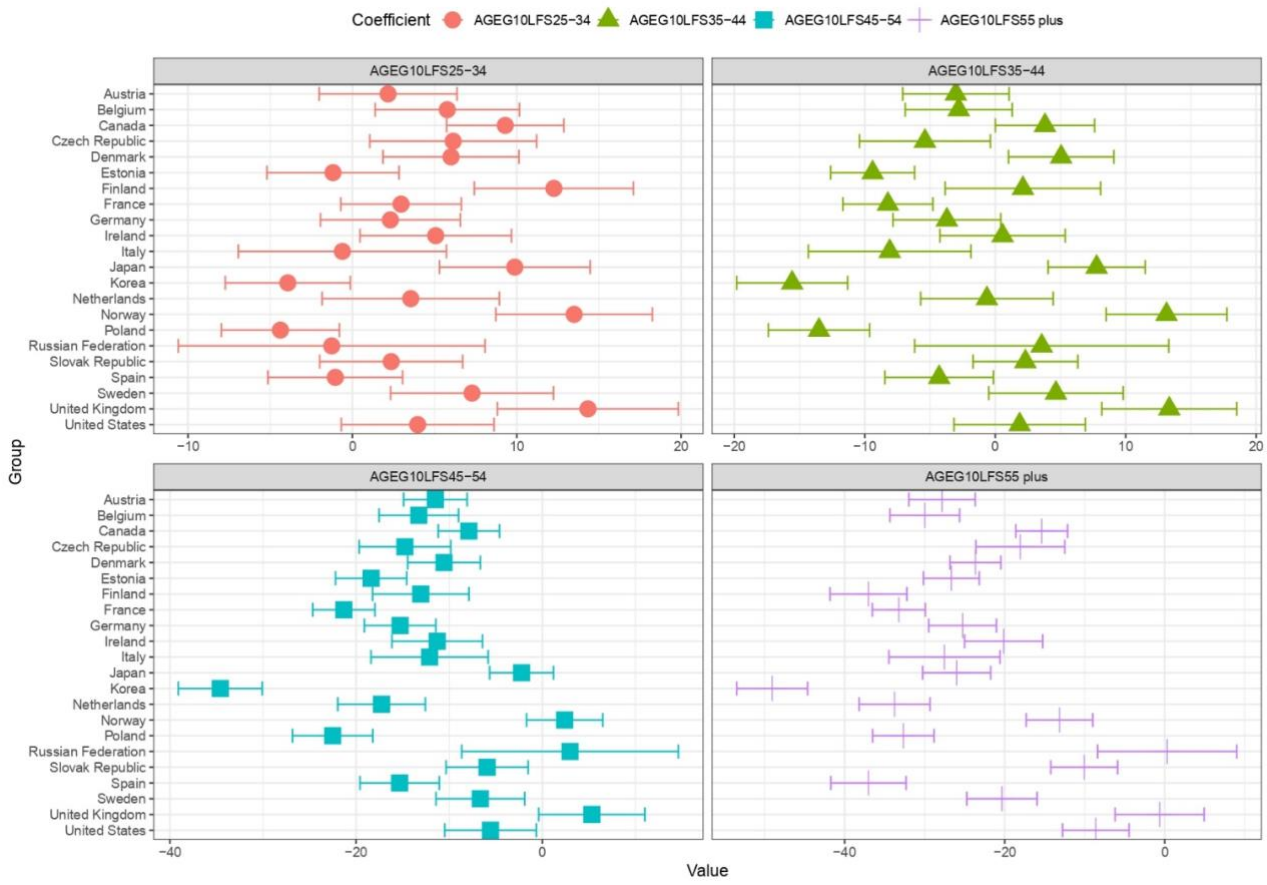
Figure 3

Coefficients of the age in the 22 countries



Estonia, Italy, Russia, and Spain have similar behaviors in both age ranges. When comparing the population between 35 and 44 years old, it is observed that there is no clear trend between countries. College-age students have better averages in Korea, Norway, Denmark, France, Italy and the Czech Republic.

The results are more similar in countries such as Sweden, Spain, Germany, Austria and Belgium, although young people continue to present better results. The Netherlands and Ireland are where the results are most similar between both age ranges. The results are similar in Finland, the United States, the Slovak Republic, Finland, Russia, Sweden, Canada and Denmark.

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However, there is a greater tendency for older people to have better results. Older people had higher literacy scores in Japan, Norway and the UK. Previous results do not show statistical significance between adults aged 24 years or younger and those aged 25 to 44 years. Adults between the ages of 45 and 54 tend to have lower literacy scores in most countries, notably Korea, Poland, and France. The results in Japan, Norway and Russia are more like those aged 24 or younger.

The average UK adult in this age range is higher than that of young people, but not by much. Adults aged 55 and over mostly scored lower than those aged 24 and under by a more significant margin than those aged 45-54, with Korea, Spain and Finland standing out. In Russia and the United Kingdom, the scores among the oldest are most like those of the youngest.

4. Conclusion

No statistical differences were observed between the literacy scores of men and women who participated in the PIAAC test. Thus Hypothesis 1 is rejected: Women present better literacy scores than men in the PIAAC test.

There is a difference between people in different age ranges. The people with the highest scores are those between 25 and 34. Older people have lower averages that only decrease over time, so hypothesis 2 is also rejected: People between 16 and 24 years old have better literacy results than older people in the PIAAC test. The best averages in literacy scores are those between 25 and 34 years of age, leaving below those under 25. A decline in literacy skills after age 44 appears more progressive after age 55.

The countries that participated in the test behaved differently, so Hypothesis 3 is also rejected: All countries behave similarly regarding the literacy scores of the PIAAC test.

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Appendix

Code in R

```
library (intsvy)
library ("usethis")
library ("devtools")
installgithub ("pbiecek/PIAAC")
library(utils)

data ("piaac", package="PIAAC" )
pmeansLCAG <- piaac. mean. pv (pvlabel="LIT" ,by =c ( "CNTRYID" ,"AGEG10LFS" , "GENDER R" ),
data = piaac, export = FALSE)
p4 <- lm(pmeansLCAG$Mean~pmeansLCAG$CNTRYID+pmeansLCAG$GENDER R+pmeansLCAG$AGEG10LFS,
data=pmeansLCAG)
summary(p4)
p3<-lm(pmeansLCAG$Mean ~ pmeansLCAG$GENDER R+pmeansLCAG$AGEG10LFS, data=pmeansLCAG)
summary(p3)
rmodelLGAC <- piaac.reg.pv(pvlabel ="LIT" ,x=c ( "GENDER R" , "AGEG10LFS" ,by ="CNTRYID" ,
data =piaac )
summary(rmodelLGAC)
plot (rmodelLGAC, vars= c ( "GENDER R" ) ,se= TRUE, sort= TRUE)
plot (rmodelLGAC, vars = c ( "AGEG10LFS" ) , se = TRUE, sort = TRUE)
pmLCAG <- piaac . mean . pv (pvlabel = "LIT" , by = c ( "CNTRYID" , "AGEG10LFS" , "GENDER R" ) ,data =piaac ,export= FALSE)
plot (pmLCAG, sort = TRUE)
```