Estimation of all-cause excess mortality by age-specific mortality patterns for countries with incomplete vital statistics: the case of Peru during the first wave of the COVID-19 pandemic

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# Summary

## Background

All-cause excess mortality is a comprehensive measure of the combined direct and indirect effects of COVID-19 on mortality. Estimates are usually derived from Civil Registration and Vital Statistics (CRVS) systems, but these do not include non-registered deaths, which may be affected by changes in vital registration coverage over time.

## Methods

Our analytical framework and empirical strategy account for registered mortality and under-registration. This provides a better estimate of the actual mortality impact of the first wave of the COVID-19 pandemic in Peru. We use population and crude mortality rate projections from Peru’s National Institute of Statistics and Information (INEI, in Spanish), individual-level registered COVID-19 deaths from the Ministry of Health (MoH) and individual-level registered deaths by region and age since 2017 from the National Electronic Deaths Register (SINADEF, in Spanish).

We develop a novel framework combining different estimates and using quasi-Poisson models to estimate total excess mortality across regions and age groups. Also, we also use logistic mixed-effects models to estimate the coverage of the new SINADEF system.

## Findings

We estimate that registered mortality underestimates national mortality by 37.1% (95% CI 23% - 48.5%) across 26 regions and nine age groups. We estimate total all-cause excess mortality during the period of analysis at 173,099 (95% CI 153,669 - 187,488) of which 108,943 (95% CI 96,507 - 118,261) were captured by the vital registration system. Deaths at age 60 and over accounted for 74.1% (95% CI 73.9% - 74.7%) of total excess deaths, and there were fewer deaths than expected in younger age groups. Lima region, on the Pacific coast and including the national capital, accounts for the highest share of excess deaths, 87,781 (95% CI 82,294 - 92,504), while in the opposite side regions of Apurimac and Huancavelica account for less than 300 excess deaths.

## Interpretation

Estimating excess mortality in low- and middle-income countries (LMICs) such as Peru must take under-registration of mortality into account. Combining demographic trends with data from administrative registries reduces uncertainty and measurement errors. In countries like Peru, this is likely to produce significantly higher estimates of excess mortality than studies that do not take these effects into account.

## Funding

None.

# Research in context

## Evidence before this study

We searched PubMed, Google Scholar, medRxiv, and SocArXiv for studies published up to May 27, 2020, using the keywords “excess mortality” and “under-registration” or “sub registration,” combined with “coronavirus” or “SARS-CoV-2” or “COVID-19.” We found studies estimating cumulative mortality in high-income countries in Europe and North America solely based on official death counts. We found studies computing overall COVID-19 mortality for a small number of LMICs. Prior research shows a significant percentage of under-registration of deaths in LMICs.

## Added-value of this study

To our knowledge, we provide the first estimate of excess mortality associated with COVID-19 in a LMIC that accounts for both registered and unregistered deaths. We develop an analytical strategy to address common challenges faced by LMICs, such as low completion rates of death certificates, missing data, and inconsistency and variability of data across regions and age groups. We show our method is robust for small samples, including for subnational regions and specific age groups.

## Implications of all the available evidence

Our approach shows the importance of accounting for unregistered deaths based on demographic trends to generate robust estimates of excess mortality associated with COVID-19. It suggests that previous reports of COVID-19 related mortality in Peru were substantial underestimates.

# Introduction

Monitoring mortality is an essential part of the public health response to the COVID-19 pandemic. In many countries, COVID-19 mortality monitoring has been hindered by failures to capture all deaths or to accurately attribute cause of death.1 Disentangling the contribution of COVID-19 to overall mortality is especially challenging, as many people who die from COVID-19 have other conditions, such as cardiovascular disease and diabetes.2 Some countries apply different cut-off times between a positive COVID-19 test and death, when attributing mortality to this cause.3 Also, the pandemic has led to large numbers of deaths not directly attributable to COVID-19 (either exclusively or in part), due to effects including reduced access to treatment for other conditions.4,5 Conversely, there is evidence that lockdowns have sometimes reduced expected rates of mortality from causes such as road traffic injuries and homicides.6

In the absence of good data on these different effects, robust estimation of all-cause excess mortality offers the most complete and reliable approach for gauging the overall impact of the pandemic in a defined population over a fixed period.7 Excess mortality refers to the number of additional deaths occurring over a time period when specific conditions apply (in this case, the presence of COVID-19), compared to the number of deaths we might reasonably expect over the same period based on historical data. It captures deaths directly attributed to COVID-19 and those resulting from other consequences of the pandemic, to provide an estimate of the overall mortality effect.8

Excess mortality estimates based on registered deaths have been computed for high-income countries by surveillance agencies,9,10 academia11–14 and the media.15–18 However, these data are often incomplete or inaccurate, especially in many low and middle-income countries (LMICs). The Global Burden Disease (GBD) estimates only 64% of global deaths were registered in 2015.19 In most LMICs, responsibility for mortality data is divided between different national and subnational agencies.20 This can cause extended delays in national reporting and discrepancies between different sources.12,21 Disaggregation of summary data by different geographical areas or demographic groups is usually very limited.22 These shortcomings explain the lack of published studies of excess mortality in LMICs.23,24

We deploy an array of analytical tools to address these issues and apply them to the case of Peru during the first wave of the pandemic. Between 18 March and December 31 2020, the country reported 36,036 deaths directly caused by COVID-19. This official figure only includes cases with positive COVID-19 test results, but rates of testing in Peru have been low compared to other Latin American countries,25 and many tests have used low sensitivity devices, potentially generating false negatives.26 Like much of Latin America, Peru has experienced high levels of COVID-19 mortality, with certain areas showing high rates of seroprevalence of anti-SARS-CoV-2 antibodies such as the capital city Lima27 and extremely high rates in Iquitos (in Amazonia).28 Multiple explanations could be made such as poor health investment, high poverty rates and informal employment.29

A recent study undertaken in association with the government, applying a wider set of indirect criteria to identify 89,844 deaths potentially attributable to the condition occurred over a similar period.30 This applies a unique and controversial methodology: for example, it categorises any death in households where at least one person tested positive for COVID-19 as potential COVID-19 death even if the dead person was not tested. Given the level of uncertainty about COVID-19 mortality in Peru, estimates of excess all-cause deaths offer a more instructive indicator of the pandemic’s impact. However, substantial gaps in death registration represent a barrier to producing robust estimates. Peru is a geographically diverse country (Figure 1), but does not report registration rates at these levels, hindering analysis of geographical and age patterns. Studies from other LMICs show registration coverage often varies significantly between sub-regions and age groups.31,32 In 2017, Peru implemented a new online register with increasing coverage over time although lower than the manual system,33 placing anonymised individual-level data on mortality and COVID-19 in the public domain.34 Consequently, comparisons over time must take increased registration into account.

[FIGURE 1 ABOUT HERE]

# Data and methods

## Data

We use data from two Ministry of Health (MoH) mortality registration systems. Anonymised individual-level registered deaths from the National Electronic Deaths Register (SINADEF, in Spanish) from 2017 to 2020 are divided into 26 regions and 9 age groups. In 2017 Peru shifted from a paper-based system to an electronic one, which led to a growth in coverage (from 98,552 in 2017 to 114,449 in 2019). However, coverage remains unequal among regions,34 impeding comparisons of spatial and temporal trends. Additionally, we use anonymised individual-level registered deaths by region and age group from MoH COVID-19 tracking systems. Both sets of data include day of death, age, sex, day of birth and administrative region was collected on May 30 2021. Table 1 summarises the main descriptive statistics for the SINADEF and COVID-19 databases. We also use population and mortality projections for recent years, by region and age group, from Peru’s National Institute of Statistics and Information (INEI, in Spanish). These projections are based on decennial censuses (the most recent in 2017) and annual health and population surveys.35

[TABLE 1 ABOUT HERE]

Figure 2 shows weekly registered deaths by region for 2017 to 2020. All regions, other than Apurimac, saw an initial peak at some point between week 20 to week 40. All regions then saw significant declines, although a second peak occurred in Lima and Pasco in weeks 50 to 52. We also observe that the weekly mortality growth varies across time. We restrict our excess mortality analysis to those weeks where a significant change can be detected for each region, using 0.60% as a threshold criterion of weekly change36 (vertical lines in Figure 2).

[FIGURE 2 ABOUT HERE]

## Excess mortality methods

Figure 3 presents our approach to estimate excess mortality. This can be decomposed into three terms: (i) excess SINADEF registered deaths; (ii) excess unregistered deaths; and (iii) unregistered COVID-19 deaths. Figure 4 summarises our empirical strategy based on data sources used (squares), statistical analysis performed (diamonds) and outputs (circles).

[FIGURE 3 ABOUT HERE]

[FIGURE 4 ABOUT HERE]

The first term, excess SINADEF registered deaths - -, we first fit quasi-Poisson regressions to address the over-dispersed nature of the data to weekly deaths, , as follows:

where we fit a natural cubic B-spline function on weeks and Fourier series (with yearly periods and 6 pairs of sines and cosines) to address long-term trends and seasonality.37 Additionally, we use lagged residuals and the log of the population in 2020, as an offset. Finally, we compute a dichotomous variable starting in the week corresponding to the pandemic onset for each region (Figure 2). We calculate the relative risk of those under a statistical significance threshold (p<.05) to compute excess registered mortality as a population attributable fraction (PAF),38 as follows:

where is the weekly number of deaths39 and represents a fraction of the total mortality of the period where in equation (1).

The second term, excess unregistered deaths - -, estimates mortality delayed or absent in official registers and is computed as a fraction of . We start by predicting SINADEF completeness by modelling random-effects logistic regressions40 for each region using for 2017 and 2019, represented by . We exploit variability in INEI mortality rates, population aged 60 years and over and rurality to address potential differences in terms of registration completeness, using the equation:

where and are the Crude Death Rates, is registration coverage of deaths rate for infants -as a relevant proxy measure of overall mortality registration in a population-,40 is the logarithm under-five mortality rate and represents the fraction of the population at 60 years and over based on INEI projections. is the share of households that use liquefied petroleum gas for cooking. This is an acceptable proxy for rurality in Peru, as 81.8% of rural households primarily use solid fuel compared to 9.8% of urban ones, who typically cook with liquefied petroleum gas.41 Rurality is an important factor to explain delay and under-registration of deaths as the system requires access to internet and computers. Additionally, is the error term and is the region-level random effect. is computed using the inverse logit of the predicted values, which provides a regionally adjusted SINADEF completeness rate, assuming the highest value between the two periods.

Finally, excess unregistered deaths is based on from equation (2) and from equation (3), as follows:

The last term, unregistered COVID-19 deaths, , is computed to correct for situations where the proportion of cumulative cases of reported COVID-19 deaths for that period exceeds SINADEF values. This occurs mostly in younger age groups. The calculation is conditional on excess registered deaths being lower than officially registered COVID-19 deaths for each region and specific age group as follows:

Finally, we estimate total excess deaths for different scenarios.

A first scenario is when there is no solid evidence suggesting under-registration of deaths for some regions or age groups and, therefore, no scope to expand registration over time. This usually occurs in areas and age groups with very small populations. In those cases, is set to 0 to avoid adding negative values to the sum. A second scenario relates to younger age groups who in some regions have not been significantly affected by COVID-19 mortality. This case occurs when in equation (1) is not statistically significant and therefore we set . A third scenario is when some groups have fewer deaths than expected, due to effects such as reduced road traffic injuries. In these groups and are included in the final estimate. A fourth scenario is when models underestimate the official number of deaths such as . In this case, we use the former as registered deaths. Equation (6) summarises the estimation of as follows:

Finally, we estimate total mortality during 2020 by adding from equation (6) and SINADEF expected deaths for 2020, , adjusted by from equation (3), as follows:

To address the relative level of mortality in 2020, we compute all-cause age-standardised death rates per 1,000 people derived from the estimated total excess deaths. We apply direct standardization methods42 using INEI population estimates by region and age group for 2020 as the standard population.43

As a robustness check for excess mortality estimates, we estimate a mortality baseline for each age group fitting either a Generalised Linear Model with Poisson or Negative binomial distributions, depending on the data’s over-dispersion. The model includes natural splines and sinusoidal components to account for secular changes and seasonality in mortality, as well as interpolated weekly exposures to control for changes in age structure over time. 95% prediction intervals were estimated using 2,000 bootstrapping iterations. Excess mortality is computed as the difference between observed mortality and the baseline, only including weeks in which observed mortality was above the upper prediction interval.

# Results

Estimates of completeness of SINADEF registration derived from our logistic regression model fit the data according to marginal and conditional and Root Mean Square of Errors parameters. Model fit and goodness-of-fit are presented in Appendix 1.

As a data validity test, we compare our estimations with the available data in the CRVS system for 2017 and 2019 (Figure 5). We find strong correlations between both estimations across years (r(25) = .81 and .87, p< .01, two-tailed). CRVS based estimation shows several values (to the right of vertical lines) where SINADEF registration is larger than CRVS, specially when completeness is in the higher end. For 2019, while the CRVS system estimates 159,706 deaths, we predict 189,991 which is very similar to INEI estimations (188,043). This is consistent with current estimations of CRVS completeness gaps.44

[FIGURE 5 ABOUT HERE]

Logistic regression based on SINADEF shows an outlier value for Lambayeque (bottom of right panel), which is reflects a consistent lack of registration during 2019. We address those anomalities choosing the highest registration completeness proportion for each region. Figure 6 shows important variations in regional completeness rates: Amazonas and Loreto (in Amazonia), and Pasco and Cajamarca (in the Andes) show estimated completion at below 50%, while Ica (coast) and Madre De Dios (Peru’s least populated region in Amazonia) appear to have complete registration (Appendix 1).

[FIGURE 6 ABOUT HERE]

Figure 7 shows observed and predicted values for excess registered mortality by age group and region. These values show both seasonality and growth. This, along with the high number of statistically significant parameters across regressions, indicates the model fits the data. As such, the variable COVID-19 correctly identifies a significant change in mortality patterns across time. See Appendix 1 for statistics and goodness-of-fit analysis.

[FIGURE 7 ABOUT HERE]

Table 2 summarises our estimates of excess mortality. Excess registered mortality is estimated to be 108,943(95% CI 96,507 - 118,261), of which 37,725 are reported as COVID-19 deaths. Excess unregistered mortality is estimated to be 62,933 deaths (95% CI 68,005 - 55,940), making up 58.9% (95% CI 46% - 79.4%) of our estimate of total registered and unregistered deaths. This third term adds 1,222 deaths corresponding to cases when reported COVID-19 deaths exceed our estimate of adjusted excess registered mortality. Combining all these terms, our estimate of total excess deaths during 2020 is 173,099 (95% CI 153,669 - 187,488) and our estimate of total deaths for 2020 is 334,043 (95% CI 300,147 - 367,743). This is 73.8% (95% CI 56.2% - 91.3%) more than the number of deaths projected by INEI for 2020 (192,215),45 and 14.3% (95% CI 13.5- 14.5) higher estimations based on CRVS data in 2019. See Appendix 1 for results and comparison with robustness analysis.

[TABLE 2 ABOUT HERE]

Table 3 shows estimates by region. Lima, which includes the capital, accounts for 87781 (95% CI 82294 - 92504) total excess deaths, and Apurimac and Huancavelica show the lowest numbers. Coastal regions have the highest values of excess unregistered deaths, with Lima accounting for 36,856 additional deaths, followed by Piura (7,928) and Lambayeque (3,540). The highest under-reported COVID-19 mortality occurs in the Andean regions of Ayacucho (192) and Apurimac (150), along with Ucayali, in Amazonia (117).

[TABLE 3 ABOUT HERE]

Table 4 shows excess mortality estimates by age group. Deaths among people aged 60 years and over account for 74.1% of total excess mortality. There was negative excess registered mortality for the youngest age groups.Under-reported COVID-19 mainly occurs for groups at younger ages.

[TABLE 4 ABOUT HERE]

Figure 8 shows all-cause age-standardised death rates. Callao, Piura, and Lima (CI 95% ranging from 10.1 to 13.9) have the highest rates, ranging from 10.3 to 13.9. Lambayeque, Cusco, and Amazonas show the lowest rates ranging from 4.44 to 7.98 (CI 95% ranging from 4.33 to 8.26). Figure 8 also shows differences in deaths per 1000 compared to INEI’s projections for 2020. There is excess mortality in all cases but Lambayeque, Amazonas, and Cusco. These three regions show differences of up to -1.12 suggesting that INEI projections overestimate mortality for there regions in 2020 and thate there was lower use of the CRVS system than expected.

[FIGURE 8 ABOUT HERE]

# Discussion

Most published studies of excess COVID-19 mortality fall into two categories. Some studies provide estimates for countries where mortality data are relatively complete and reliable.46–49 As such, they do not apply specific methods to address data gaps. Studies of excess COVID-19 mortality for countries with less complete data do not take account of unregistered deaths.50–54

Our estimates are broadly compatible with the official data update, which applies a wider set of indirect criteria to Peru to identify “probable COVID-19 deaths.” That study estimates 89,844 potential COVID-19 deaths during wave 1 of the pandemic, compared to our estimate of 212,313 for excess registered all-cause mortality for the similar period of time. Our estimation represents an overall excess mortality 93% (95% CI 71% - 109%) higher than the latest official figures. Registered excess mortality was 21% (95% CI 7% - 32%) higher. This is a larger differential than reported by studies in high-income countries. For example, separate studies of the USA show differentials of between 28 and 33%.11,12 Our overall estimates are also higher than in several studies previously published for Peru.55–57

Other studies show that unregistered mortality tends to be more prevalent among older people.40 A study of registered excess mortality in six Brazilian cities reports that people aged 60 and over accounted for 71.1% of the total.52 An analysis of European countries reports that 91% of excess COVID-19 deaths occurred among people aged 65 or more.48 Despite making up a relatively low share of Peru’s population (12.5% in 2020), we find people aged 60 or more accounted for 73.9% of estimated excess mortality. No other published study in Peru provides data disaggregated by age groups. The negative excess mortality among those under 10 is a reminder that the measures taken to restrict the spread of SARS-CoV-2 are associated with reductions in other causes of death, such as road injuries and street violence. They can also be expected to reduce transmission of other airborne viruses, including influenza, with transmission virtually halted in winter 2020/21 and childhood infections such as respiratory syncytial virus. The impact of these changes will, of course, vary according to their historic importance in overall mortality.

Our finding that unregistered mortality tends to be higher in poorer regions is consistent with studies of other LMICs.58 Our estimates of regional variations for excess mortality in Peru are in line with a separate study,55 which posits they may be in part attributable to the effect of altitude on COVID-19 case fatality.

Our analysis is limited by data availability and robustness. We do not take account potential SINADEF registration growth during 2020. We do not include it due to lack of robust historical data that allows for robust estimations to avoid possible confounding with demographic changes and other potential unknown exogenous shocks. Comparisons with projected mortality rates confirm that our estimates are realistic in all regions other than Amazonas. Amazonas and Lambayeque are also examples of poor data reliability, in case of INEI projections or SINADEF, respectively.

We also make several assumptions to simplify our analysis. We assume comparison between years is not invalidated by specific time-bound mortality events, such as additional disease outbreaks or other external shocks. We found no evidence of such events for the period in question. Our estimates of registration completeness assume no variation across age groups and assume a linear progression in registration, which may not be the case. Additionally, our estimates are based on provisional data, which remain incomplete and may subsequently be revised. Finally, we present a conservative scenario, allowing for both negative and positive excess mortality.

There is an evident need for robust estimates of the direct and indirect mortality effects of the COVID-19 pandemic. To date, much of the data for LMICs rely on officially registered deaths. Inaccurate attribution of cause of death can, to some degree, be resolved by generating excess mortality estimates based on comparisons of all-cause mortality over time. However, it is also necessary to include deaths that are not officially registered.

This paper develops and applies a method to obtain robust excess mortality estimates for both registered and unregistered deaths. These estimates suggest that official data for Peru substantially under-represent the overall mortality impact of wave 1 the pandemic, and that this gap is much greater than those reported for high-income countries.

It is plausible that the degree of under-estimation of excess mortality in other countries with low-quality mortality data will be comparable to Peru. The framework, tools and analytical strategy applied in this paper may be useful for generating similar estimates for these countries.59 In Colombia, for example, data quality is similar to Peru’s and a recent reform of its CRVS system is likely to have boosted registration rates in the recent years.60 There is an urgent need to extend this research, in order to demonstrate the true toll of the COVID-19 pandemic, both globally and especially in LMICs.

# Contributors

LS conceived and initiated the study, did the statistical analysis and visualisations and drafted the manuscript.

PLS conceived and supervised the study, drafted the manuscript and led the editing process of the manuscript.

MM and SE supervised the study and engaged in the draft review & editing

RM contributed to the data curation and methodology process and reviewed & edited the draft.

EA contributed to data curation, methodology and statistical analysis.

LS and EA had access to all the data. All authors approved the manuscript and are responsible for the decision to submit it for publication.

# Declaration of interests

RM is a staff member of the Pan American Health Organization. The author alone is responsible for the views expressed in this publication, and they do not necessarily represent the decisions or policies of the Pan American Health Organization.

All other authors declare no competing interests.

# Data sharing

Data presented in this manuscript are made publicly available at <https://github.com/lsempe77/excess>

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# Figures and tables

## Figure 1

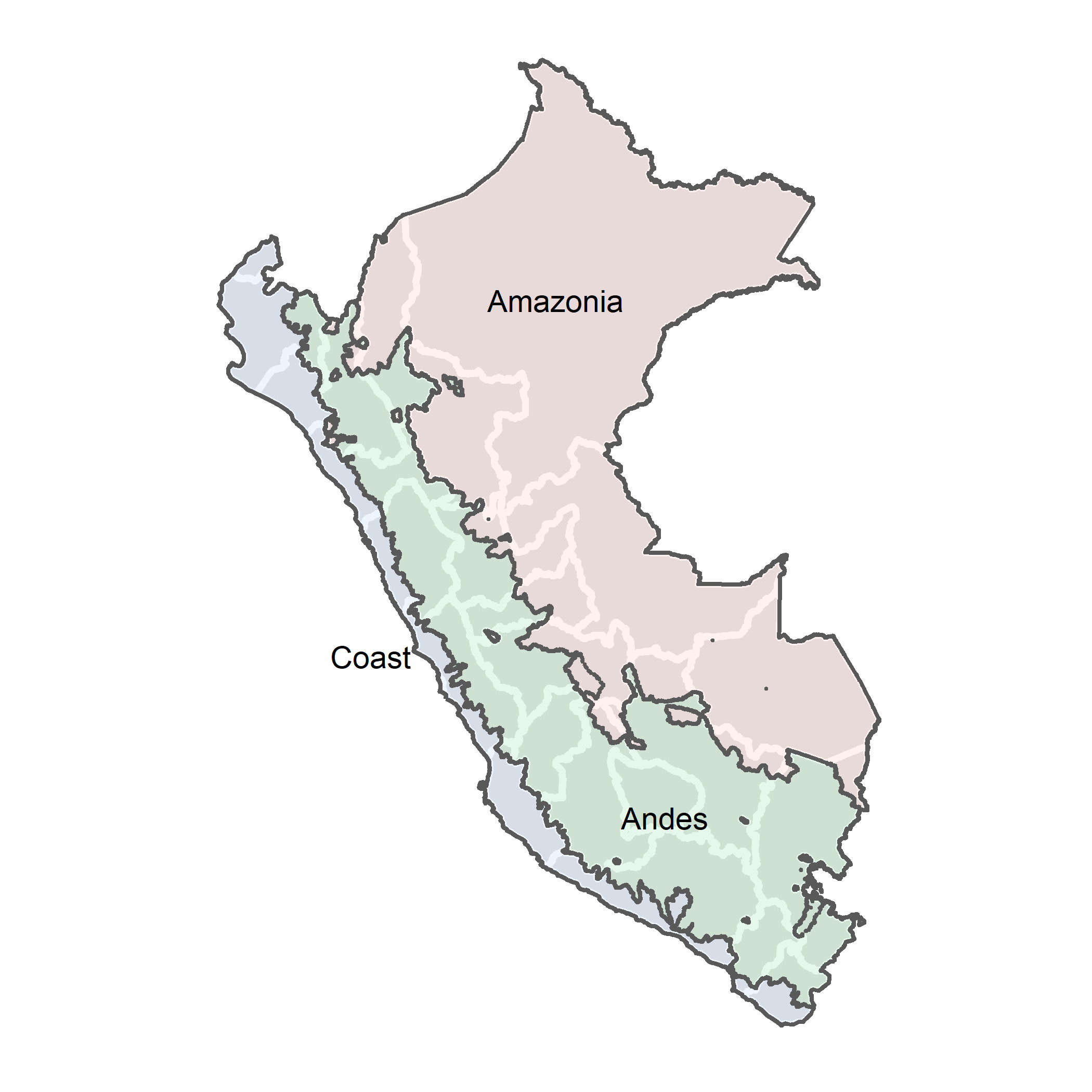


Figure 1: Natural and administrative regions - Peru

## Figure 2

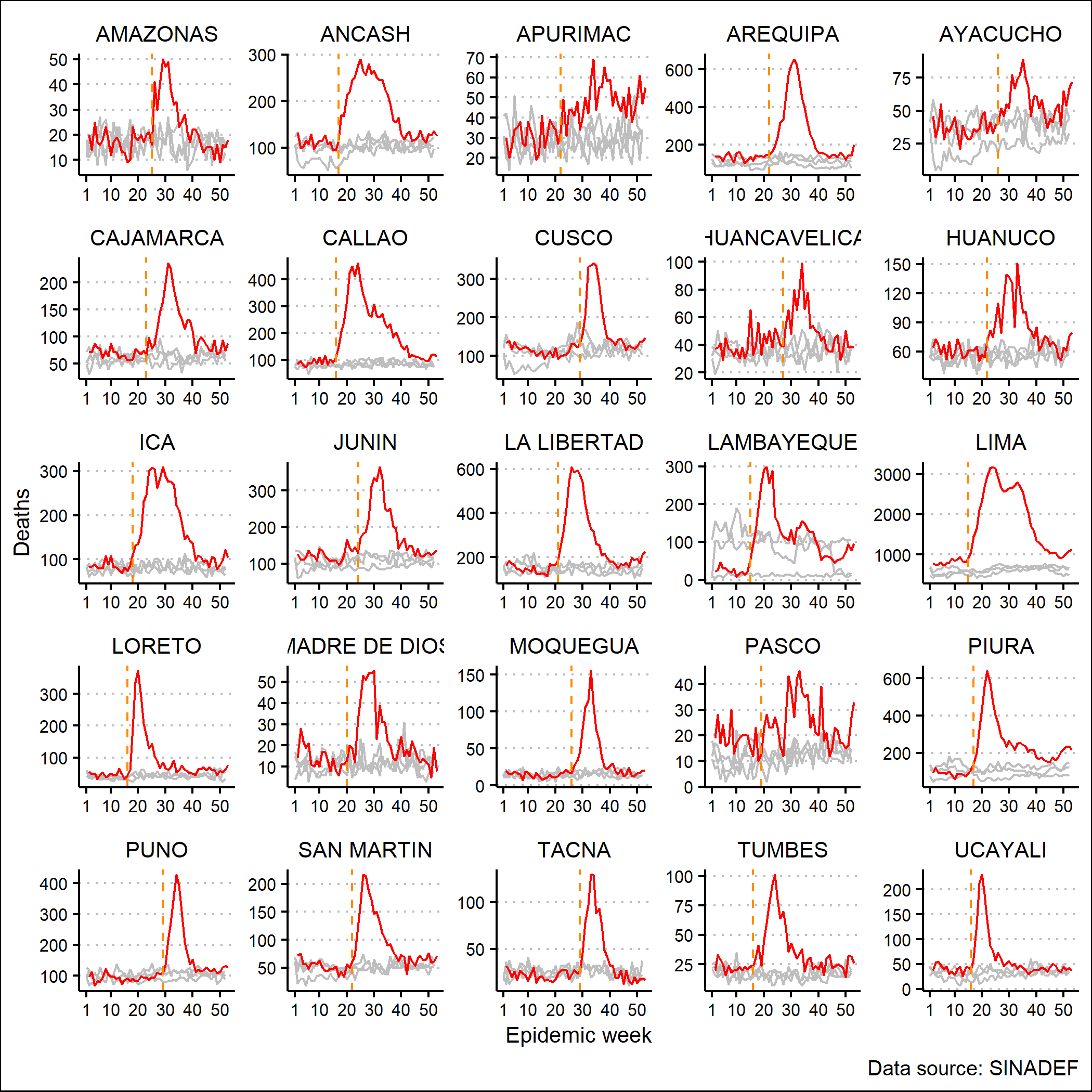


Figure 2: Weekly deaths during 2017-2020 by Region - Peru. Grey lines indicate deaths during years 2017 to 2019 and red lines during 2020. Vertical dashed lines indicate the starting and ending point of the first pandemic wave in each region.

## Figure 3

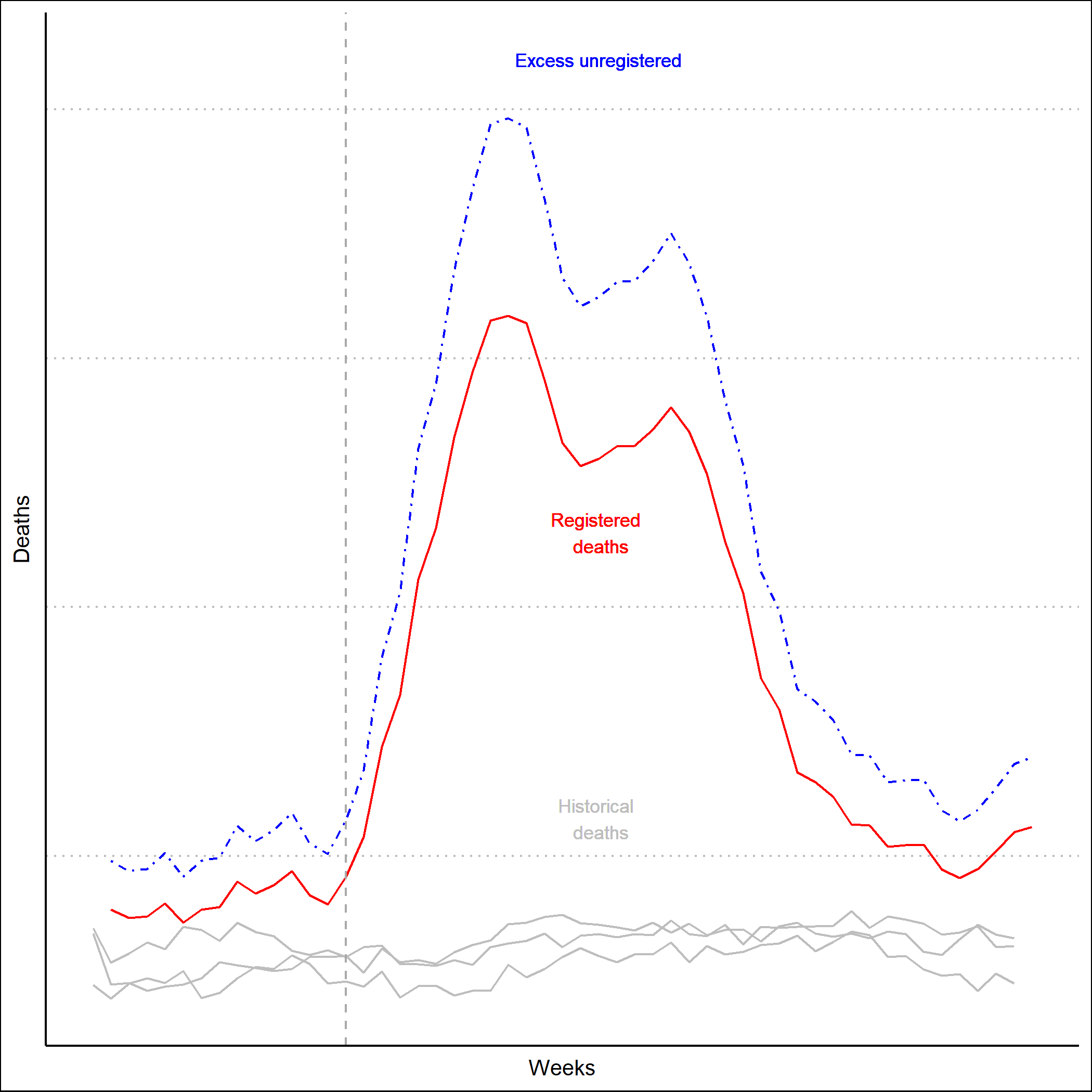


Figure 3: Conceptual representation of empirical strategy

## Figure 4

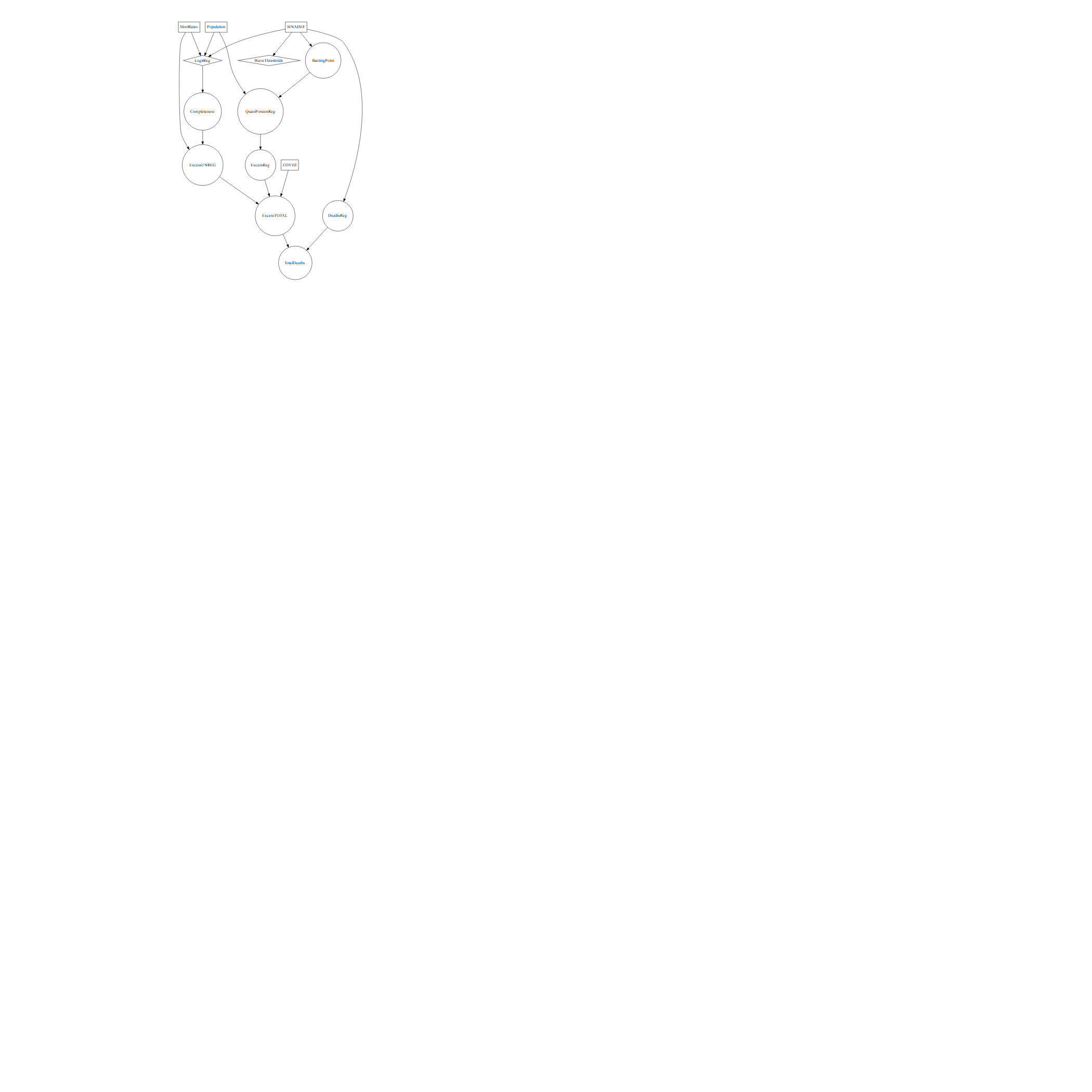


Figure 4: Flowchart: Data, analysis and outputs

## Figure 5

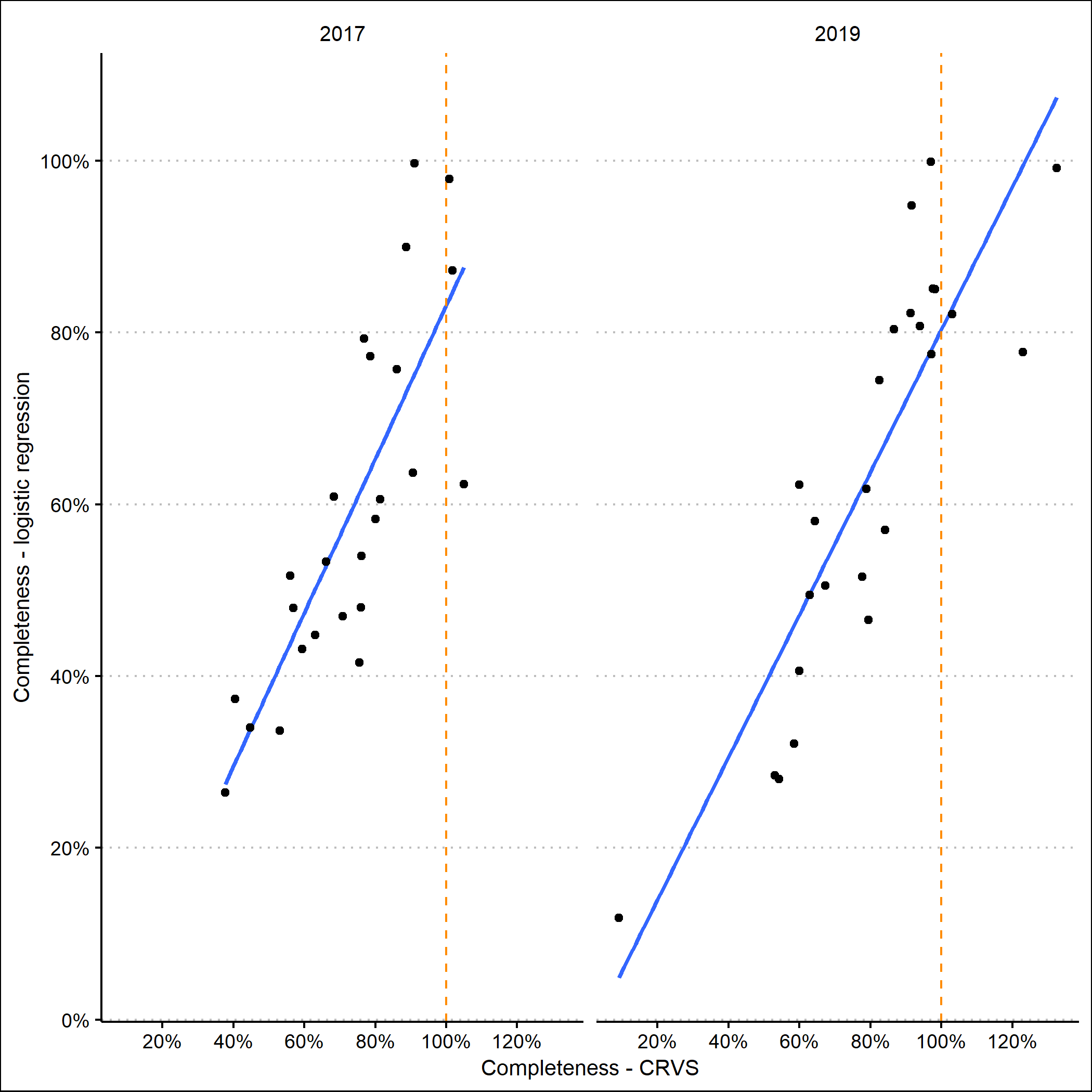


Figure 5: Comparison of completeness methods

## Figure 6

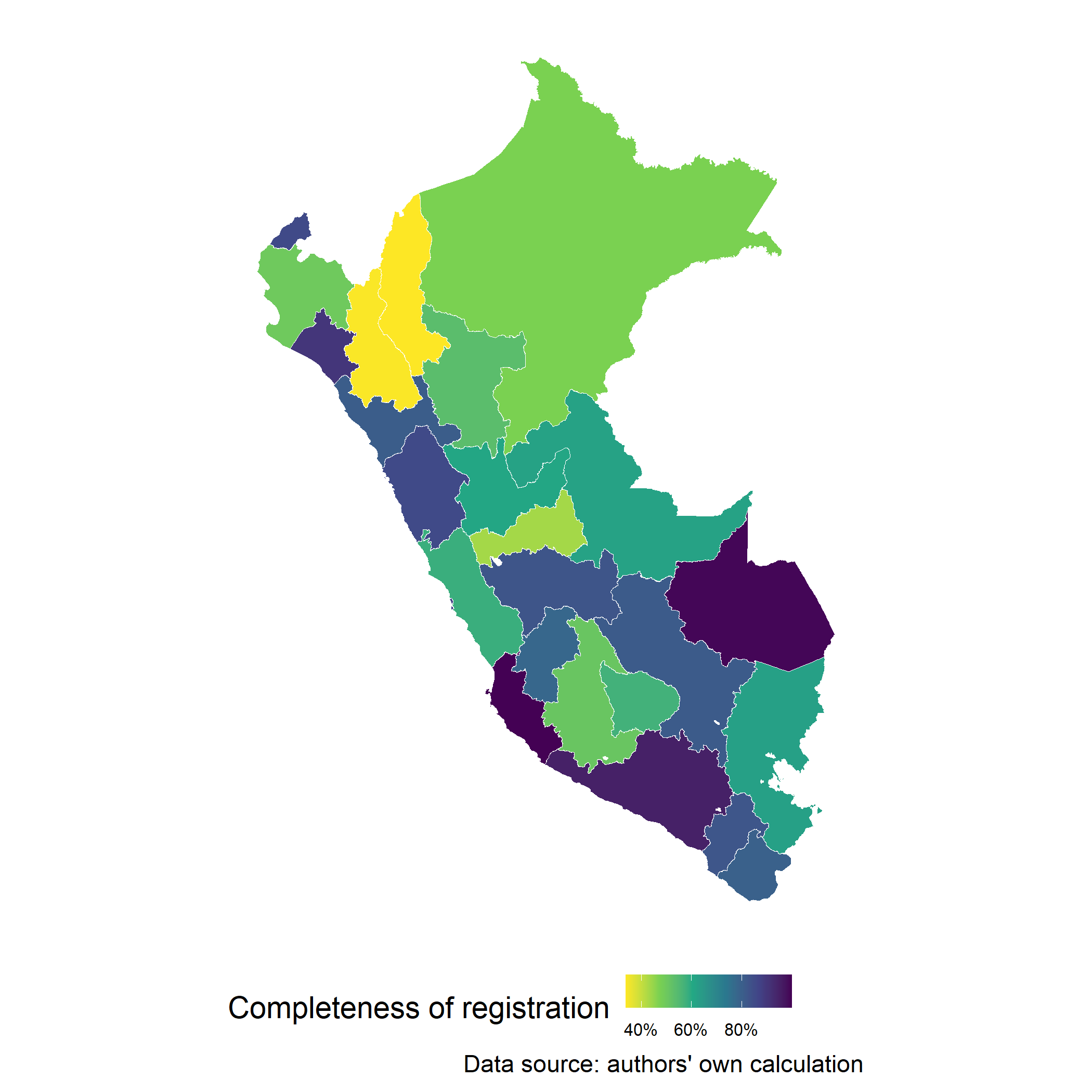


Figure 6: Estimation SINADEF completeness of registration before pandemics - Peru

## Figure 7

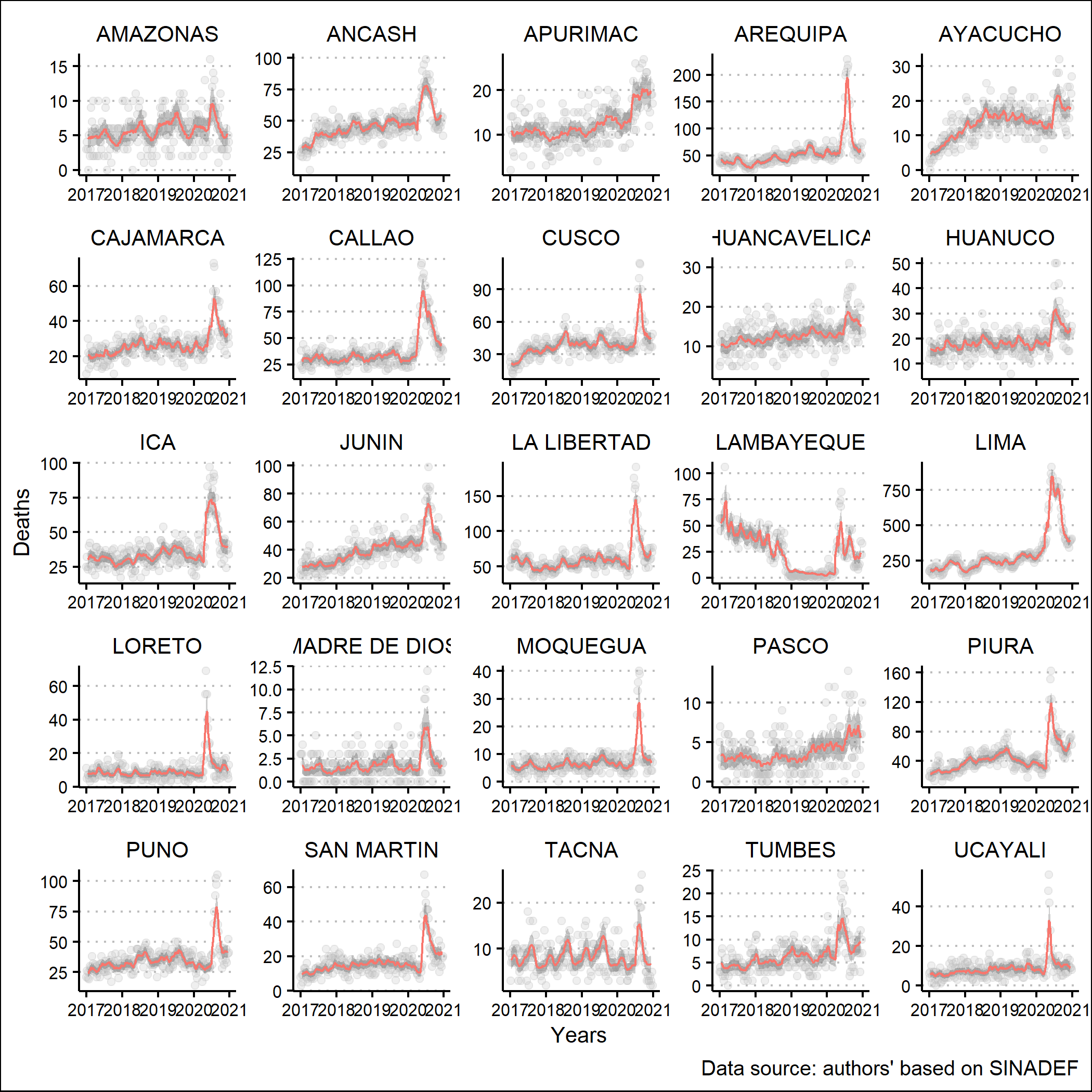


Figure 7: Predicted excess registered mortality by Region for age group over 80 - Peru

## Figure 8

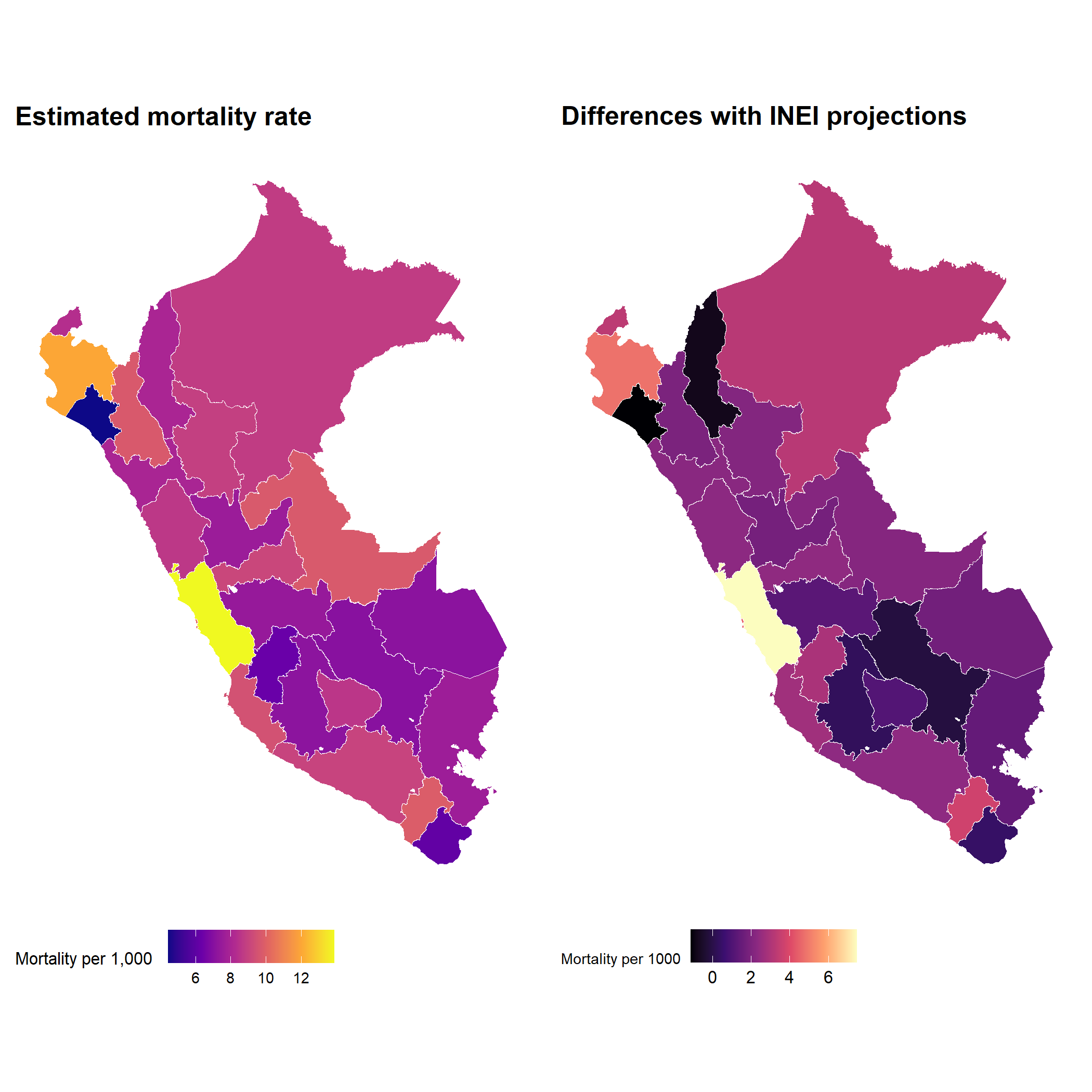


Figure 8: Estimated age-standardised mortality rates and differences with INEI projections

## Table 1

Table 1: Descriptive statistics - SINADEF & COVID-19 data

|  |  |  |  |
| --- | --- | --- | --- |
| Data | Observations | Age (sd) | % males |
| SINADEF 2017-2020 | 537054 | 66.35 (23.46) | 56 |
| COVID-19 | 36036 | 65.96 (14.66) | 68.8 |

## Table 2

Table 2: Summary of estimations, Peru, 2020.

|  |  |
| --- | --- |
| Terms | Estimates (95% CI) |
| COVID-19 deaths (MoH) | 1222 |
| Excess registered deaths | 108943 (96507 - 118261) |
| SINADEF completeness registration | 62.9% (51.5% - 77%) |
| Total excess mortality | 173099 (153669 - 187488) |
| Total estimated deaths in 2020 | 334043 (300147 - 367743) |

## Table 3

Table 3: Estimated total excess deaths by region

|  |  |  |
| --- | --- | --- |
| Region | Total excess | Excess registered |
| AMAZONAS | 873 (424 - 1016) | 264 (170 - 314) |
| ANCASH | 4155 (3408 - 4756) | 3490 (2851 - 3999) |
| APURIMAC | 260 (182 - 292) | 62 (18 - 81) |
| AREQUIPA | 5616 (4873 - 6207) | 5273 (4564 - 5829) |
| AYACUCHO | 891 (464 - 1145) | 353 (181 - 482) |
| CAJAMARCA | 5345 (4012 - 6291) | 1806 (1369 - 2129) |
| CALLAO | 7144 (6536 - 7610) | 6215 (5680 - 6617) |
| CUSCO | 2272 (1566 - 2823) | 1811 (1237 - 2253) |
| HUANCAVELICA | 307 (209 - 376) | 154 (77 - 207) |
| HUANUCO | 1623 (639 - 2236) | 960 (440 - 1330) |
| ICA | 4252 (3691 - 4678) | 4226 (3659 - 4645) |
| JUNIN | 3096 (2255 - 3759) | 2526 (1823 - 3067) |
| LA LIBERTAD | 8091 (7152 - 8819) | 6502 (5742 - 7082) |
| LAMBAYEQUE | 4964 (4782 - 5074) | 4437 (4268 - 4531) |
| LIMA | 87781 (82294 - 92504) | 50925 (47738 - 53666) |
| LORETO | 5962 (5252 - 6386) | 2784 (2475 - 2984) |
| MADRE DE DIOS | 500 (319 - 607) | 492 (284 - 591) |
| MOQUEGUA | 1087 (884 - 1205) | 889 (718 - 982) |
| PASCO | 658 (174 - 894) | 261 (68 - 363) |
| PIURA | 15661 (14575 - 16465) | 7733 (7196 - 8131) |
| PUNO | 4071 (3289 - 4661) | 2526 (2037 - 2891) |
| SAN MARTIN | 3534 (2775 - 4081) | 1870 (1447 - 2162) |
| TACNA | 958 (715 - 1112) | 755 (558 - 873) |
| TUMBES | 1160 (893 - 1326) | 984 (753 - 1120) |
| UCAYALI | 2841 (2307 - 3166) | 1645 (1152 - 1932) |

## Table 4

Table 4: Estimated total excess deaths by age group

|  |  |  |
| --- | --- | --- |
| Age range | Total excess | Excess registered |
| < 10 | 209 (141 - 259) | -53 (-262 - 64) |
| 10-19 | 221 (134 - 272) | 91 (20 - 131) |
| 20-29 | 1407 (774 - 1826) | 732 (354 - 980) |
| 30-39 | 4261 (2899 - 5138) | 2592 (1698 - 3151) |
| 40-49 | 12697 (11168 - 13739) | 8009 (6995 - 8693) |
| 50-59 | 26114 (23687 - 27763) | 16440 (14939 - 17493) |
| 60-69 | 42528 (39316 - 44858) | 26719 (24719 - 28200) |
| 70-79 | 43260 (38903 - 46469) | 27356 (24702 - 29402) |
| > 79 | 42401 (36648 - 47164) | 27057 (23341 - 30147) |

# Appendices

## Appendix 1

### Population 2020 per region

Table 5: Population 2020 per region

|  |  |
| --- | --- |
| Departamento | pop.INEI |
| MADRE DE DIOS | 153164 |
| MOQUEGUA | 189701 |
| TUMBES | 251363 |
| PASCO | 314677 |
| TACNA | 362331 |
| AMAZONAS | 427202 |
| APURIMAC | 467707 |
| HUANCAVELICA | 511794 |
| UCAYALI | 523086 |
| AYACUCHO | 725649 |
| ICA | 825042 |
| HUANUCO | 888845 |
| SAN MARTIN | 894564 |
| CALLAO | 1081491 |
| LORETO | 1085375 |
| ANCASH | 1177080 |
| LAMBAYEQUE | 1309731 |
| CUSCO | 1352476 |
| AREQUIPA | 1358108 |
| JUNIN | 1398361 |
| PUNO | 1485328 |
| CAJAMARCA | 1544325 |
| PIURA | 1914346 |
| LA LIBERTAD | 1973446 |
| LIMA | 10609166 |

### Model fit registration completeness

Table 6: Model fit Mixed-effect logistic regression

|  |  |  |  |
| --- | --- | --- | --- |
| R2m | R2c | RMSE.normalised | RMSE |
| 0.7437 | 0.8699 | 0.05268 | 0.239 |

### Under-registration rates

Table 7: Under-registration rates

|  |  |
| --- | --- |
| Departamento | sub.mean |
| ICA | 99.85 |
| ICA | 99.7 |
| MADRE DE DIOS | 99.18 |
| MADRE DE DIOS | 97.89 |
| AREQUIPA | 94.78 |
| LAMBAYEQUE | 89.92 |
| CALLAO | 87.23 |
| ANCASH | 85.12 |
| TUMBES | 85.03 |
| JUNIN | 82.28 |
| MOQUEGUA | 82.14 |
| CUSCO | 80.78 |
| LA LIBERTAD | 80.41 |
| TACNA | 79.27 |
| HUANCAVELICA | 77.72 |
| CALLAO | 77.51 |
| LA LIBERTAD | 77.26 |
| TUMBES | 75.74 |
| TACNA | 74.43 |
| MOQUEGUA | 63.67 |
| HUANCAVELICA | 62.35 |
| PUNO | 62.26 |
| UCAYALI | 61.83 |
| AREQUIPA | 60.89 |
| HUANUCO | 60.59 |
| ANCASH | 58.29 |
| LIMA | 58.07 |
| APURIMAC | 57 |
| JUNIN | 53.96 |
| SAN MARTIN | 53.32 |
| LIMA | 51.7 |
| SAN MARTIN | 51.55 |
| AYACUCHO | 50.54 |
| PIURA | 49.46 |
| CUSCO | 47.98 |
| UCAYALI | 47.93 |
| LORETO | 46.99 |
| HUANUCO | 46.56 |
| PUNO | 44.79 |
| PASCO | 43.17 |
| APURIMAC | 41.6 |
| PASCO | 40.59 |
| PIURA | 37.32 |
| CAJAMARCA | 34 |
| AMAZONAS | 33.67 |
| LORETO | 32.12 |
| CAJAMARCA | 28.45 |
| AMAZONAS | 28.01 |
| AYACUCHO | 26.46 |
| LAMBAYEQUE | 11.87 |

### Quasi-Poisson models

Table 8: Model fit Quasi-Poisson

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Departamento | range | null.deviance | df.null | logLik | AIC | BIC | deviance | df.residual | nobs | fit | dif.dev | df | p |
| AMAZONAS | a0.9 | 275.7 | 206 | NA | NA | NA | 213.5 | 189 | 207 | 0.2254 | 62.12 | 17 | 4.674e-07 |
| AMAZONAS | a10.19 | 223 | 206 | NA | NA | NA | 204.7 | 189 | 207 | 0.08207 | 18.3 | 17 | 0.3703 |
| AMAZONAS | a20.29 | 207.7 | 206 | NA | NA | NA | 191.4 | 189 | 207 | 0.07888 | 16.39 | 17 | 0.4966 |
| AMAZONAS | a30.39 | 242.3 | 206 | NA | NA | NA | 210.1 | 189 | 207 | 0.1328 | 32.17 | 17 | 0.01433 |
| AMAZONAS | a40.49 | 232.5 | 206 | NA | NA | NA | 205.8 | 189 | 207 | 0.1147 | 26.66 | 17 | 0.0633 |
| AMAZONAS | a50.59 | 260.6 | 206 | NA | NA | NA | 210.1 | 189 | 207 | 0.1938 | 50.5 | 17 | 0.00003528 |
| AMAZONAS | a60.69 | 392.6 | 206 | NA | NA | NA | 252 | 189 | 207 | 0.358 | 140.5 | 17 | 1.729e-21 |
| AMAZONAS | a70.79 | 285.3 | 206 | NA | NA | NA | 231.6 | 189 | 207 | 0.1882 | 53.69 | 17 | 0.00001109 |
| AMAZONAS | a80 | 291.1 | 206 | NA | NA | NA | 234.2 | 189 | 207 | 0.1955 | 56.92 | 17 | 3.36e-06 |
| ANCASH | a0.9 | 240.9 | 206 | NA | NA | NA | 202 | 189 | 207 | 0.1615 | 38.9 | 17 | 0.001846 |
| ANCASH | a10.19 | 225.8 | 206 | NA | NA | NA | 214.3 | 189 | 207 | 0.05078 | 11.47 | 17 | 0.8313 |
| ANCASH | a20.29 | 219.5 | 206 | NA | NA | NA | 203.8 | 189 | 207 | 0.07114 | 15.61 | 17 | 0.5514 |
| ANCASH | a30.39 | 235.8 | 206 | NA | NA | NA | 201.3 | 189 | 207 | 0.1462 | 34.49 | 17 | 0.007252 |
| ANCASH | a40.49 | 370.5 | 206 | NA | NA | NA | 222.8 | 189 | 207 | 0.3986 | 147.7 | 17 | 7.004e-23 |
| ANCASH | a50.59 | 769.7 | 206 | NA | NA | NA | 244.3 | 189 | 207 | 0.6826 | 525.4 | 17 | 8.43e-101 |
| ANCASH | a60.69 | 1102 | 206 | NA | NA | NA | 248.7 | 189 | 207 | 0.7744 | 853.8 | 17 | 1.537e-170 |
| ANCASH | a70.79 | 1083 | 206 | NA | NA | NA | 266.8 | 189 | 207 | 0.7538 | 816.6 | 17 | 1.346e-162 |
| ANCASH | a80 | 749.1 | 206 | NA | NA | NA | 251.2 | 189 | 207 | 0.6647 | 498 | 17 | 5.11e-95 |
| APURIMAC | a0.9 | 241.7 | 206 | NA | NA | NA | 227.8 | 189 | 207 | 0.05727 | 13.84 | 17 | 0.6783 |
| APURIMAC | a10.19 | 211.6 | 206 | NA | NA | NA | 187.5 | 189 | 207 | 0.1142 | 24.17 | 17 | 0.115 |
| APURIMAC | a20.29 | 247.1 | 206 | NA | NA | NA | 228.1 | 189 | 207 | 0.07703 | 19.03 | 17 | 0.3266 |
| APURIMAC | a30.39 | 251 | 206 | NA | NA | NA | 221.6 | 189 | 207 | 0.1172 | 29.42 | 17 | 0.03085 |
| APURIMAC | a40.49 | 285.6 | 206 | NA | NA | NA | 258.9 | 189 | 207 | 0.09351 | 26.71 | 17 | 0.06251 |
| APURIMAC | a50.59 | 282.8 | 206 | NA | NA | NA | 228.1 | 189 | 207 | 0.1936 | 54.77 | 17 | 7.473e-06 |
| APURIMAC | a60.69 | 343.1 | 206 | NA | NA | NA | 262.2 | 189 | 207 | 0.2357 | 80.86 | 17 | 2.699e-10 |
| APURIMAC | a70.79 | 263.9 | 206 | NA | NA | NA | 195.2 | 189 | 207 | 0.2602 | 68.65 | 17 | 3.671e-08 |
| APURIMAC | a80 | 372.2 | 206 | NA | NA | NA | 212.3 | 189 | 207 | 0.4295 | 159.8 | 17 | 2.847e-25 |
| AREQUIPA | a0.9 | 280.9 | 206 | NA | NA | NA | 252.8 | 189 | 207 | 0.1 | 28.09 | 17 | 0.04391 |
| AREQUIPA | a10.19 | 256.9 | 206 | NA | NA | NA | 238.2 | 189 | 207 | 0.07301 | 18.76 | 17 | 0.3426 |
| AREQUIPA | a20.29 | 229.9 | 206 | NA | NA | NA | 200.2 | 189 | 207 | 0.1293 | 29.74 | 17 | 0.02828 |
| AREQUIPA | a30.39 | 278.8 | 206 | NA | NA | NA | 214.6 | 189 | 207 | 0.2303 | 64.18 | 17 | 2.109e-07 |
| AREQUIPA | a40.49 | 632.9 | 206 | NA | NA | NA | 274.2 | 189 | 207 | 0.5668 | 358.8 | 17 | 7.38e-66 |
| AREQUIPA | a50.59 | 1486 | 206 | NA | NA | NA | 325.1 | 189 | 207 | 0.7813 | 1161 | 17 | 2.992e-236 |
| AREQUIPA | a60.69 | 2421 | 206 | NA | NA | NA | 346.4 | 189 | 207 | 0.8569 | 2075 | 17 | 0 |
| AREQUIPA | a70.79 | 2436 | 206 | NA | NA | NA | 334.8 | 189 | 207 | 0.8625 | 2101 | 17 | 0 |
| AREQUIPA | a80 | 2587 | 206 | NA | NA | NA | 321.3 | 189 | 207 | 0.8758 | 2266 | 17 | 0 |
| AYACUCHO | a0.9 | 337.6 | 206 | NA | NA | NA | 261.5 | 189 | 207 | 0.2254 | 76.1 | 17 | 1.874e-09 |
| AYACUCHO | a10.19 | 257 | 206 | NA | NA | NA | 225.8 | 189 | 207 | 0.1215 | 31.22 | 17 | 0.01877 |
| AYACUCHO | a20.29 | 233.3 | 206 | NA | NA | NA | 193.6 | 189 | 207 | 0.17 | 39.64 | 17 | 0.001453 |
| AYACUCHO | a30.39 | 262 | 206 | NA | NA | NA | 215.1 | 189 | 207 | 0.179 | 46.89 | 17 | 0.0001266 |
| AYACUCHO | a40.49 | 329.3 | 206 | NA | NA | NA | 259.6 | 189 | 207 | 0.2114 | 69.62 | 17 | 2.51e-08 |
| AYACUCHO | a50.59 | 316.9 | 206 | NA | NA | NA | 231.7 | 189 | 207 | 0.269 | 85.23 | 17 | 4.447e-11 |
| AYACUCHO | a60.69 | 374.8 | 206 | NA | NA | NA | 208 | 189 | 207 | 0.4451 | 166.8 | 17 | 1.199e-26 |
| AYACUCHO | a70.79 | 490.1 | 206 | NA | NA | NA | 225.1 | 189 | 207 | 0.5408 | 265.1 | 17 | 1.736e-46 |
| AYACUCHO | a80 | 460.4 | 206 | NA | NA | NA | 195.8 | 189 | 207 | 0.5748 | 264.6 | 17 | 2.127e-46 |
| CAJAMARCA | a0.9 | 284.4 | 206 | NA | NA | NA | 242.6 | 189 | 207 | 0.1469 | 41.78 | 17 | 0.0007205 |
| CAJAMARCA | a10.19 | 252.4 | 206 | NA | NA | NA | 236.2 | 189 | 207 | 0.0644 | 16.26 | 17 | 0.5058 |
| CAJAMARCA | a20.29 | 251.1 | 206 | NA | NA | NA | 223.3 | 189 | 207 | 0.1106 | 27.77 | 17 | 0.04774 |
| CAJAMARCA | a30.39 | 275.6 | 206 | NA | NA | NA | 228.2 | 189 | 207 | 0.172 | 47.42 | 17 | 0.0001053 |
| CAJAMARCA | a40.49 | 262.1 | 206 | NA | NA | NA | 180 | 189 | 207 | 0.3134 | 82.14 | 17 | 1.593e-10 |
| CAJAMARCA | a50.59 | 547.4 | 206 | NA | NA | NA | 234.4 | 189 | 207 | 0.5717 | 313 | 17 | 2.356e-56 |
| CAJAMARCA | a60.69 | 867.5 | 206 | NA | NA | NA | 291.5 | 189 | 207 | 0.6639 | 576 | 17 | 1.736e-111 |
| CAJAMARCA | a70.79 | 692.2 | 206 | NA | NA | NA | 269.6 | 189 | 207 | 0.6105 | 422.6 | 17 | 3.484e-79 |
| CAJAMARCA | a80 | 531.2 | 206 | NA | NA | NA | 237.8 | 189 | 207 | 0.5524 | 293.5 | 17 | 2.489e-52 |
| CALLAO | a0.9 | 305.8 | 206 | NA | NA | NA | 278.2 | 189 | 207 | 0.09016 | 27.57 | 17 | 0.05026 |
| CALLAO | a10.19 | 251.5 | 206 | NA | NA | NA | 234.8 | 189 | 207 | 0.06629 | 16.67 | 17 | 0.4768 |
| CALLAO | a20.29 | 268.3 | 206 | NA | NA | NA | 251.7 | 189 | 207 | 0.06184 | 16.59 | 17 | 0.4822 |
| CALLAO | a30.39 | 295.5 | 206 | NA | NA | NA | 212.3 | 189 | 207 | 0.2817 | 83.23 | 17 | 1.017e-10 |
| CALLAO | a40.49 | 722.5 | 206 | NA | NA | NA | 226.4 | 189 | 207 | 0.6866 | 496.1 | 17 | 1.248e-94 |
| CALLAO | a50.59 | 1458 | 206 | NA | NA | NA | 303.8 | 189 | 207 | 0.7915 | 1154 | 17 | 1.119e-234 |
| CALLAO | a60.69 | 2350 | 206 | NA | NA | NA | 354.5 | 189 | 207 | 0.8492 | 1996 | 17 | 0 |
| CALLAO | a70.79 | 1973 | 206 | NA | NA | NA | 321.9 | 189 | 207 | 0.8369 | 1651 | 17 | 0 |
| CALLAO | a80 | 1411 | 206 | NA | NA | NA | 346.4 | 189 | 207 | 0.7545 | 1064 | 17 | 1.579e-215 |
| CUSCO | a0.9 | 283.9 | 206 | NA | NA | NA | 202.7 | 189 | 207 | 0.2861 | 81.22 | 17 | 2.332e-10 |
| CUSCO | a10.19 | 214.4 | 206 | NA | NA | NA | 182.6 | 189 | 207 | 0.1486 | 31.86 | 17 | 0.01564 |
| CUSCO | a20.29 | 274.3 | 206 | NA | NA | NA | 226 | 189 | 207 | 0.1761 | 48.29 | 17 | 0.00007747 |
| CUSCO | a30.39 | 225.2 | 206 | NA | NA | NA | 181.4 | 189 | 207 | 0.1945 | 43.78 | 17 | 0.0003686 |
| CUSCO | a40.49 | 369 | 206 | NA | NA | NA | 265.8 | 189 | 207 | 0.2797 | 103.2 | 17 | 2.267e-14 |
| CUSCO | a50.59 | 456.5 | 206 | NA | NA | NA | 266.1 | 189 | 207 | 0.4171 | 190.4 | 17 | 2.376e-31 |
| CUSCO | a60.69 | 813.6 | 206 | NA | NA | NA | 326.6 | 189 | 207 | 0.5985 | 486.9 | 17 | 1.061e-92 |
| CUSCO | a70.79 | 663 | 206 | NA | NA | NA | 275.3 | 189 | 207 | 0.5848 | 387.7 | 17 | 6.791e-72 |
| CUSCO | a80 | 829.7 | 206 | NA | NA | NA | 279.6 | 189 | 207 | 0.663 | 550.1 | 17 | 5.037e-106 |
| HUANCAVELICA | a0.9 | 227.6 | 206 | NA | NA | NA | 213.7 | 189 | 207 | 0.0613 | 13.95 | 17 | 0.6703 |
| HUANCAVELICA | a10.19 | 290.5 | 206 | NA | NA | NA | 262.1 | 189 | 207 | 0.09764 | 28.36 | 17 | 0.04085 |
| HUANCAVELICA | a20.29 | 251.7 | 206 | NA | NA | NA | 234.1 | 189 | 207 | 0.06997 | 17.61 | 17 | 0.4139 |
| HUANCAVELICA | a30.39 | 222.9 | 206 | NA | NA | NA | 203.4 | 189 | 207 | 0.08746 | 19.49 | 17 | 0.301 |
| HUANCAVELICA | a40.49 | 296 | 206 | NA | NA | NA | 244.5 | 189 | 207 | 0.1738 | 51.45 | 17 | 0.00002504 |
| HUANCAVELICA | a50.59 | 277.2 | 206 | NA | NA | NA | 236.7 | 189 | 207 | 0.1461 | 40.49 | 17 | 0.001104 |
| HUANCAVELICA | a60.69 | 318 | 206 | NA | NA | NA | 243.4 | 189 | 207 | 0.2345 | 74.56 | 17 | 3.494e-09 |
| HUANCAVELICA | a70.79 | 368.6 | 206 | NA | NA | NA | 254.9 | 189 | 207 | 0.3084 | 113.7 | 17 | 2.421e-16 |
| HUANCAVELICA | a80 | 260.7 | 206 | NA | NA | NA | 198.9 | 189 | 207 | 0.2372 | 61.85 | 17 | 5.194e-07 |
| HUANUCO | a0.9 | 213.1 | 206 | NA | NA | NA | 184.5 | 189 | 207 | 0.134 | 28.55 | 17 | 0.03888 |
| HUANUCO | a10.19 | 273.6 | 206 | NA | NA | NA | 254.4 | 189 | 207 | 0.07026 | 19.22 | 17 | 0.3159 |
| HUANUCO | a20.29 | 198.1 | 206 | NA | NA | NA | 172.5 | 189 | 207 | 0.1294 | 25.64 | 17 | 0.08127 |
| HUANUCO | a30.39 | 247.7 | 206 | NA | NA | NA | 217.1 | 189 | 207 | 0.1235 | 30.6 | 17 | 0.02233 |
| HUANUCO | a40.49 | 272.2 | 206 | NA | NA | NA | 230.3 | 189 | 207 | 0.154 | 41.92 | 17 | 0.0006879 |
| HUANUCO | a50.59 | 329.1 | 206 | NA | NA | NA | 251.4 | 189 | 207 | 0.2359 | 77.62 | 17 | 1.01e-09 |
| HUANUCO | a60.69 | 421.4 | 206 | NA | NA | NA | 216.3 | 189 | 207 | 0.4866 | 205.1 | 17 | 2.718e-34 |
| HUANUCO | a70.79 | 362.8 | 206 | NA | NA | NA | 218.4 | 189 | 207 | 0.398 | 144.4 | 17 | 3.082e-22 |
| HUANUCO | a80 | 360.9 | 206 | NA | NA | NA | 225.8 | 189 | 207 | 0.3742 | 135 | 17 | 1.988e-20 |
| ICA | a0.9 | 194.3 | 206 | NA | NA | NA | 180.7 | 189 | 207 | 0.07006 | 13.61 | 17 | 0.6943 |
| ICA | a10.19 | 228.7 | 206 | NA | NA | NA | 214.8 | 189 | 207 | 0.06078 | 13.9 | 17 | 0.674 |
| ICA | a20.29 | 269 | 206 | NA | NA | NA | 251.2 | 189 | 207 | 0.06621 | 17.81 | 17 | 0.4009 |
| ICA | a30.39 | 317.7 | 206 | NA | NA | NA | 255.4 | 189 | 207 | 0.1958 | 62.21 | 17 | 4.519e-07 |
| ICA | a40.49 | 568.2 | 206 | NA | NA | NA | 244.3 | 189 | 207 | 0.5701 | 323.9 | 17 | 1.27e-58 |
| ICA | a50.59 | 1030 | 206 | NA | NA | NA | 259.4 | 189 | 207 | 0.7481 | 770.4 | 17 | 9.15e-153 |
| ICA | a60.69 | 1668 | 206 | NA | NA | NA | 308.2 | 189 | 207 | 0.8153 | 1360 | 17 | 5.234e-279 |
| ICA | a70.79 | 1128 | 206 | NA | NA | NA | 287.9 | 189 | 207 | 0.7448 | 840.1 | 17 | 1.264e-167 |
| ICA | a80 | 934.3 | 206 | NA | NA | NA | 319.9 | 189 | 207 | 0.6576 | 614.4 | 17 | 1.3e-119 |
| JUNIN | a0.9 | 242.5 | 206 | NA | NA | NA | 224.7 | 189 | 207 | 0.07334 | 17.79 | 17 | 0.4024 |
| JUNIN | a10.19 | 247.6 | 206 | NA | NA | NA | 229.9 | 189 | 207 | 0.07115 | 17.61 | 17 | 0.4135 |
| JUNIN | a20.29 | 207.2 | 206 | NA | NA | NA | 181.8 | 189 | 207 | 0.1227 | 25.42 | 17 | 0.08577 |
| JUNIN | a30.39 | 278.8 | 206 | NA | NA | NA | 219.3 | 189 | 207 | 0.2136 | 59.54 | 17 | 1.252e-06 |
| JUNIN | a40.49 | 438.3 | 206 | NA | NA | NA | 262.4 | 189 | 207 | 0.4012 | 175.9 | 17 | 1.918e-28 |
| JUNIN | a50.59 | 814 | 206 | NA | NA | NA | 292.3 | 189 | 207 | 0.6409 | 521.7 | 17 | 5.092e-100 |
| JUNIN | a60.69 | 1019 | 206 | NA | NA | NA | 319.9 | 189 | 207 | 0.6859 | 698.7 | 17 | 1.655e-137 |
| JUNIN | a70.79 | 826.2 | 206 | NA | NA | NA | 257.9 | 189 | 207 | 0.6878 | 568.3 | 17 | 7.234e-110 |
| JUNIN | a80 | 731.7 | 206 | NA | NA | NA | 237.2 | 189 | 207 | 0.6758 | 494.5 | 17 | 2.791e-94 |
| LA LIBERTAD | a0.9 | 247.5 | 206 | NA | NA | NA | 227.7 | 189 | 207 | 0.0802 | 19.85 | 17 | 0.2818 |
| LA LIBERTAD | a10.19 | 272.8 | 206 | NA | NA | NA | 237.2 | 189 | 207 | 0.1306 | 35.63 | 17 | 0.005144 |
| LA LIBERTAD | a20.29 | 272.7 | 206 | NA | NA | NA | 247.8 | 189 | 207 | 0.09108 | 24.83 | 17 | 0.09853 |
| LA LIBERTAD | a30.39 | 281.8 | 206 | NA | NA | NA | 219.3 | 189 | 207 | 0.2217 | 62.47 | 17 | 4.092e-07 |
| LA LIBERTAD | a40.49 | 524.4 | 206 | NA | NA | NA | 200.1 | 189 | 207 | 0.6184 | 324.3 | 17 | 1.088e-58 |
| LA LIBERTAD | a50.59 | 1406 | 206 | NA | NA | NA | 357.2 | 189 | 207 | 0.746 | 1049 | 17 | 3.037e-212 |
| LA LIBERTAD | a60.69 | 2225 | 206 | NA | NA | NA | 390.5 | 189 | 207 | 0.8245 | 1835 | 17 | 0 |
| LA LIBERTAD | a70.79 | 1934 | 206 | NA | NA | NA | 390.7 | 189 | 207 | 0.798 | 1543 | 17 | 2.557e-318 |
| LA LIBERTAD | a80 | 1272 | 206 | NA | NA | NA | 326.4 | 189 | 207 | 0.7433 | 945.3 | 17 | 4.386e-190 |
| LAMBAYEQUE | a0.9 | 523.3 | 206 | NA | NA | NA | 244.1 | 189 | 207 | 0.5335 | 279.2 | 17 | 2.21e-49 |
| LAMBAYEQUE | a10.19 | 292 | 206 | NA | NA | NA | 212.3 | 189 | 207 | 0.273 | 79.71 | 17 | 4.323e-10 |
| LAMBAYEQUE | a20.29 | 372.2 | 206 | NA | NA | NA | 256.9 | 189 | 207 | 0.3099 | 115.4 | 17 | 1.176e-16 |
| LAMBAYEQUE | a30.39 | 402.4 | 206 | NA | NA | NA | 251.8 | 189 | 207 | 0.3741 | 150.5 | 17 | 1.927e-23 |
| LAMBAYEQUE | a40.49 | 822.8 | 206 | NA | NA | NA | 325.7 | 189 | 207 | 0.6042 | 497.1 | 17 | 7.591e-95 |
| LAMBAYEQUE | a50.59 | 1460 | 206 | NA | NA | NA | 377.4 | 189 | 207 | 0.7415 | 1082 | 17 | 2.033e-219 |
| LAMBAYEQUE | a60.69 | 2318 | 206 | NA | NA | NA | 456 | 189 | 207 | 0.8033 | 1862 | 17 | 0 |
| LAMBAYEQUE | a70.79 | 2335 | 206 | NA | NA | NA | 446.3 | 189 | 207 | 0.8088 | 1888 | 17 | 0 |
| LAMBAYEQUE | a80 | 3888 | 206 | NA | NA | NA | 700.2 | 189 | 207 | 0.8199 | 3188 | 17 | 0 |
| LIMA | a0.9 | 347.5 | 206 | NA | NA | NA | 268 | 189 | 207 | 0.2288 | 79.51 | 17 | 4.68e-10 |
| LIMA | a10.19 | 253.7 | 206 | NA | NA | NA | 212.6 | 189 | 207 | 0.1622 | 41.15 | 17 | 0.0008874 |
| LIMA | a20.29 | 407.2 | 206 | NA | NA | NA | 286 | 189 | 207 | 0.2977 | 121.2 | 17 | 8.985e-18 |
| LIMA | a30.39 | 1253 | 206 | NA | NA | NA | 247.2 | 189 | 207 | 0.8027 | 1005 | 17 | 6.23e-203 |
| LIMA | a40.49 | 4853 | 206 | NA | NA | NA | 371.9 | 189 | 207 | 0.9234 | 4481 | 17 | 0 |
| LIMA | a50.59 | 12216 | 206 | NA | NA | NA | 725.9 | 189 | 207 | 0.9406 | 11490 | 17 | 0 |
| LIMA | a60.69 | 20231 | 206 | NA | NA | NA | 1022 | 189 | 207 | 0.9495 | 19209 | 17 | 0 |
| LIMA | a70.79 | 17310 | 206 | NA | NA | NA | 1005 | 189 | 207 | 0.9419 | 16305 | 17 | 0 |
| LIMA | a80 | 14399 | 206 | NA | NA | NA | 770.8 | 189 | 207 | 0.9465 | 13628 | 17 | 0 |
| LORETO | a0.9 | 248.6 | 206 | NA | NA | NA | 228.5 | 189 | 207 | 0.08073 | 20.07 | 17 | 0.2707 |
| LORETO | a10.19 | 266.6 | 206 | NA | NA | NA | 228 | 189 | 207 | 0.1447 | 38.58 | 17 | 0.002047 |
| LORETO | a20.29 | 236.1 | 206 | NA | NA | NA | 216.2 | 189 | 207 | 0.08431 | 19.91 | 17 | 0.2791 |
| LORETO | a30.39 | 286.8 | 206 | NA | NA | NA | 215.8 | 189 | 207 | 0.2476 | 71 | 17 | 1.448e-08 |
| LORETO | a40.49 | 448.9 | 206 | NA | NA | NA | 213.2 | 189 | 207 | 0.5251 | 235.7 | 17 | 1.733e-40 |
| LORETO | a50.59 | 833.3 | 206 | NA | NA | NA | 285.2 | 189 | 207 | 0.6578 | 548.2 | 17 | 1.317e-105 |
| LORETO | a60.69 | 1626 | 206 | NA | NA | NA | 425.6 | 189 | 207 | 0.7382 | 1200 | 17 | 1.142e-244 |
| LORETO | a70.79 | 1381 | 206 | NA | NA | NA | 391.5 | 189 | 207 | 0.7164 | 989 | 17 | 2.002e-199 |
| LORETO | a80 | 807.9 | 206 | NA | NA | NA | 315.1 | 189 | 207 | 0.61 | 492.8 | 17 | 6.197e-94 |
| MADRE DE DIOS | a0.9 | 317.4 | 206 | NA | NA | NA | 271.1 | 189 | 207 | 0.1457 | 46.23 | 17 | 0.0001592 |
| MADRE DE DIOS | a10.19 | 210.2 | 206 | NA | NA | NA | 192.6 | 189 | 207 | 0.08391 | 17.64 | 17 | 0.4119 |
| MADRE DE DIOS | a20.29 | 240 | 206 | NA | NA | NA | 219.4 | 189 | 207 | 0.08547 | 20.51 | 17 | 0.249 |
| MADRE DE DIOS | a30.39 | 276.5 | 206 | NA | NA | NA | 242.5 | 189 | 207 | 0.1232 | 34.06 | 17 | 0.008252 |
| MADRE DE DIOS | a40.49 | 296.4 | 206 | NA | NA | NA | 238.6 | 189 | 207 | 0.1949 | 57.79 | 17 | 2.426e-06 |
| MADRE DE DIOS | a50.59 | 388.3 | 206 | NA | NA | NA | 239.7 | 189 | 207 | 0.3828 | 148.7 | 17 | 4.463e-23 |
| MADRE DE DIOS | a60.69 | 421.8 | 206 | NA | NA | NA | 241.8 | 189 | 207 | 0.4268 | 180 | 17 | 2.848e-29 |
| MADRE DE DIOS | a70.79 | 356.7 | 206 | NA | NA | NA | 229.5 | 189 | 207 | 0.3566 | 127.2 | 17 | 6.432e-19 |
| MADRE DE DIOS | a80 | 326.5 | 206 | NA | NA | NA | 233.5 | 189 | 207 | 0.2848 | 92.98 | 17 | 1.75e-12 |
| MOQUEGUA | a0.9 | 227.5 | 206 | NA | NA | NA | 210 | 189 | 207 | 0.07712 | 17.55 | 17 | 0.4178 |
| MOQUEGUA | a10.19 | 158.8 | 206 | NA | NA | NA | 145.3 | 189 | 207 | 0.08505 | 13.51 | 17 | 0.7015 |
| MOQUEGUA | a20.29 | 218.4 | 206 | NA | NA | NA | 188.3 | 189 | 207 | 0.138 | 30.14 | 17 | 0.02534 |
| MOQUEGUA | a30.39 | 201.9 | 206 | NA | NA | NA | 172.6 | 189 | 207 | 0.1448 | 29.24 | 17 | 0.03241 |
| MOQUEGUA | a40.49 | 312.6 | 206 | NA | NA | NA | 231.6 | 189 | 207 | 0.259 | 80.96 | 17 | 2.588e-10 |
| MOQUEGUA | a50.59 | 466.5 | 206 | NA | NA | NA | 249 | 189 | 207 | 0.4662 | 217.5 | 17 | 8.443e-37 |
| MOQUEGUA | a60.69 | 672.4 | 206 | NA | NA | NA | 250.8 | 189 | 207 | 0.627 | 421.6 | 17 | 5.693e-79 |
| MOQUEGUA | a70.79 | 766.6 | 206 | NA | NA | NA | 263 | 189 | 207 | 0.657 | 503.7 | 17 | 3.172e-96 |
| MOQUEGUA | a80 | 523.3 | 206 | NA | NA | NA | 232.8 | 189 | 207 | 0.555 | 290.4 | 17 | 1.057e-51 |
| PASCO | a0.9 | 255.5 | 206 | NA | NA | NA | 222 | 189 | 207 | 0.1308 | 33.42 | 17 | 0.009969 |
| PASCO | a10.19 | 200.5 | 206 | NA | NA | NA | 176.4 | 189 | 207 | 0.1202 | 24.1 | 17 | 0.1168 |
| PASCO | a20.29 | 233.2 | 206 | NA | NA | NA | 207.7 | 189 | 207 | 0.1095 | 25.55 | 17 | 0.08305 |
| PASCO | a30.39 | 284.9 | 206 | NA | NA | NA | 253.9 | 189 | 207 | 0.1089 | 31.03 | 17 | 0.01982 |
| PASCO | a40.49 | 269.1 | 206 | NA | NA | NA | 222.4 | 189 | 207 | 0.1736 | 46.72 | 17 | 0.0001344 |
| PASCO | a50.59 | 329 | 206 | NA | NA | NA | 227.2 | 189 | 207 | 0.3093 | 101.8 | 17 | 4.202e-14 |
| PASCO | a60.69 | 384.1 | 206 | NA | NA | NA | 236.1 | 189 | 207 | 0.3855 | 148.1 | 17 | 5.823e-23 |
| PASCO | a70.79 | 334.2 | 206 | NA | NA | NA | 233.2 | 189 | 207 | 0.3024 | 101.1 | 17 | 5.643e-14 |
| PASCO | a80 | 365.4 | 206 | NA | NA | NA | 281.5 | 189 | 207 | 0.2296 | 83.9 | 17 | 7.724e-11 |
| PIURA | a0.9 | 246 | 206 | NA | NA | NA | 203.1 | 189 | 207 | 0.1742 | 42.87 | 17 | 0.0005021 |
| PIURA | a10.19 | 263.7 | 206 | NA | NA | NA | 230.6 | 189 | 207 | 0.1255 | 33.1 | 17 | 0.01096 |
| PIURA | a20.29 | 274.8 | 206 | NA | NA | NA | 211.6 | 189 | 207 | 0.23 | 63.2 | 17 | 3.089e-07 |
| PIURA | a30.39 | 381.4 | 206 | NA | NA | NA | 218.3 | 189 | 207 | 0.4275 | 163 | 17 | 6.727e-26 |
| PIURA | a40.49 | 951.3 | 206 | NA | NA | NA | 297.8 | 189 | 207 | 0.687 | 653.5 | 17 | 6.389e-128 |
| PIURA | a50.59 | 1572 | 206 | NA | NA | NA | 246.5 | 189 | 207 | 0.8432 | 1326 | 17 | 1.508e-271 |
| PIURA | a60.69 | 3124 | 206 | NA | NA | NA | 393 | 189 | 207 | 0.8742 | 2731 | 17 | 0 |
| PIURA | a70.79 | 2393 | 206 | NA | NA | NA | 373.3 | 189 | 207 | 0.844 | 2020 | 17 | 0 |
| PIURA | a80 | 1749 | 206 | NA | NA | NA | 385.8 | 189 | 207 | 0.7794 | 1363 | 17 | 1.32e-279 |
| PUNO | a0.9 | 240 | 206 | NA | NA | NA | 183.7 | 189 | 207 | 0.2346 | 56.3 | 17 | 4.23e-06 |
| PUNO | a10.19 | 253.5 | 206 | NA | NA | NA | 226.6 | 189 | 207 | 0.1063 | 26.96 | 17 | 0.05863 |
| PUNO | a20.29 | 227.3 | 206 | NA | NA | NA | 203.3 | 189 | 207 | 0.1057 | 24.02 | 17 | 0.1188 |
| PUNO | a30.39 | 295 | 206 | NA | NA | NA | 266.4 | 189 | 207 | 0.09692 | 28.59 | 17 | 0.03852 |
| PUNO | a40.49 | 370.7 | 206 | NA | NA | NA | 221.6 | 189 | 207 | 0.4022 | 149.1 | 17 | 3.649e-23 |
| PUNO | a50.59 | 730.5 | 206 | NA | NA | NA | 297.9 | 189 | 207 | 0.5922 | 432.6 | 17 | 2.77e-81 |
| PUNO | a60.69 | 959.1 | 206 | NA | NA | NA | 274 | 189 | 207 | 0.7143 | 685.1 | 17 | 1.264e-134 |
| PUNO | a70.79 | 862.6 | 206 | NA | NA | NA | 282.7 | 189 | 207 | 0.6722 | 579.9 | 17 | 2.575e-112 |
| PUNO | a80 | 703.4 | 206 | NA | NA | NA | 264 | 189 | 207 | 0.6247 | 439.4 | 17 | 1.028e-82 |
| SAN MARTIN | a0.9 | 260.6 | 206 | NA | NA | NA | 217.5 | 189 | 207 | 0.1652 | 43.04 | 17 | 0.0004732 |
| SAN MARTIN | a10.19 | 281.1 | 206 | NA | NA | NA | 251.7 | 189 | 207 | 0.1048 | 29.47 | 17 | 0.03043 |
| SAN MARTIN | a20.29 | 197.6 | 206 | NA | NA | NA | 179.2 | 189 | 207 | 0.09308 | 18.39 | 17 | 0.3645 |
| SAN MARTIN | a30.39 | 256.6 | 206 | NA | NA | NA | 194.6 | 189 | 207 | 0.2416 | 61.99 | 17 | 4.915e-07 |
| SAN MARTIN | a40.49 | 322.8 | 206 | NA | NA | NA | 201.8 | 189 | 207 | 0.3748 | 121 | 17 | 1e-17 |
| SAN MARTIN | a50.59 | 510.9 | 206 | NA | NA | NA | 248.5 | 189 | 207 | 0.5136 | 262.4 | 17 | 6.068e-46 |
| SAN MARTIN | a60.69 | 758.5 | 206 | NA | NA | NA | 267.4 | 189 | 207 | 0.6475 | 491.1 | 17 | 1.437e-93 |
| SAN MARTIN | a70.79 | 587.8 | 206 | NA | NA | NA | 244.8 | 189 | 207 | 0.5836 | 343.1 | 17 | 1.355e-62 |
| SAN MARTIN | a80 | 743.8 | 206 | NA | NA | NA | 292.2 | 189 | 207 | 0.6072 | 451.6 | 17 | 2.865e-85 |
| TACNA | a0.9 | 278.5 | 206 | NA | NA | NA | 235 | 189 | 207 | 0.1562 | 43.49 | 17 | 0.0004068 |
| TACNA | a10.19 | 182.7 | 206 | NA | NA | NA | 173.9 | 189 | 207 | 0.04801 | 8.77 | 17 | 0.9472 |
| TACNA | a20.29 | 281 | 206 | NA | NA | NA | 258.7 | 189 | 207 | 0.07926 | 22.27 | 17 | 0.1744 |
| TACNA | a30.39 | 244 | 206 | NA | NA | NA | 219.7 | 189 | 207 | 0.09941 | 24.25 | 17 | 0.1127 |
| TACNA | a40.49 | 296.1 | 206 | NA | NA | NA | 230.2 | 189 | 207 | 0.2224 | 65.84 | 17 | 1.106e-07 |
| TACNA | a50.59 | 469.6 | 206 | NA | NA | NA | 288 | 189 | 207 | 0.3867 | 181.6 | 17 | 1.396e-29 |
| TACNA | a60.69 | 659.7 | 206 | NA | NA | NA | 282.1 | 189 | 207 | 0.5724 | 377.6 | 17 | 8.773e-70 |
| TACNA | a70.79 | 487.7 | 206 | NA | NA | NA | 261.2 | 189 | 207 | 0.4645 | 226.5 | 17 | 1.267e-38 |
| TACNA | a80 | 358.3 | 206 | NA | NA | NA | 245.3 | 189 | 207 | 0.3152 | 112.9 | 17 | 3.375e-16 |
| TUMBES | a0.9 | 235.7 | 206 | NA | NA | NA | 210.3 | 189 | 207 | 0.1077 | 25.4 | 17 | 0.08616 |
| TUMBES | a10.19 | 179.3 | 206 | NA | NA | NA | 164.6 | 189 | 207 | 0.08222 | 14.74 | 17 | 0.6139 |
| TUMBES | a20.29 | 226.6 | 206 | NA | NA | NA | 205.5 | 189 | 207 | 0.09338 | 21.16 | 17 | 0.219 |
| TUMBES | a30.39 | 231.6 | 206 | NA | NA | NA | 188.7 | 189 | 207 | 0.185 | 42.84 | 17 | 0.0005069 |
| TUMBES | a40.49 | 275.6 | 206 | NA | NA | NA | 223.3 | 189 | 207 | 0.1899 | 52.33 | 17 | 0.00001822 |
| TUMBES | a50.59 | 442.5 | 206 | NA | NA | NA | 254.3 | 189 | 207 | 0.4254 | 188.3 | 17 | 6.497e-31 |
| TUMBES | a60.69 | 576.4 | 206 | NA | NA | NA | 242.2 | 189 | 207 | 0.5797 | 334.1 | 17 | 9.743e-61 |
| TUMBES | a70.79 | 463.4 | 206 | NA | NA | NA | 265.1 | 189 | 207 | 0.428 | 198.4 | 17 | 6.138e-33 |
| TUMBES | a80 | 397.4 | 206 | NA | NA | NA | 226.8 | 189 | 207 | 0.4294 | 170.7 | 17 | 2.085e-27 |
| UCAYALI | a0.9 | 284.1 | 206 | NA | NA | NA | 221.8 | 189 | 207 | 0.2192 | 62.28 | 17 | 4.398e-07 |
| UCAYALI | a10.19 | 247.2 | 206 | NA | NA | NA | 231.4 | 189 | 207 | 0.06409 | 15.84 | 17 | 0.5349 |
| UCAYALI | a20.29 | 301.7 | 206 | NA | NA | NA | 254 | 189 | 207 | 0.158 | 47.67 | 17 | 0.00009657 |
| UCAYALI | a30.39 | 335.2 | 206 | NA | NA | NA | 266.4 | 189 | 207 | 0.2053 | 68.82 | 17 | 3.44e-08 |
| UCAYALI | a40.49 | 294.5 | 206 | NA | NA | NA | 214.5 | 189 | 207 | 0.2716 | 80.01 | 17 | 3.827e-10 |
| UCAYALI | a50.59 | 538.1 | 206 | NA | NA | NA | 254.8 | 189 | 207 | 0.5264 | 283.2 | 17 | 3.203e-50 |
| UCAYALI | a60.69 | 700.9 | 206 | NA | NA | NA | 251.3 | 189 | 207 | 0.6415 | 449.6 | 17 | 7.401e-85 |
| UCAYALI | a70.79 | 958.3 | 206 | NA | NA | NA | 325.8 | 189 | 207 | 0.66 | 632.5 | 17 | 1.854e-123 |
| UCAYALI | a80 | 632.7 | 206 | NA | NA | NA | 319.4 | 189 | 207 | 0.4951 | 313.3 | 17 | 2.039e-56 |

### Age-standardised deaths rates

Table 9: Age-standardised deaths rates

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Departamento | adj.rate | lci | uci | crude.rate | 2010 | 2015 | Difference |
| AMAZONAS | 7.984 | 7.718 | 8.256 | 5.375 | 6.05 | 6.19 | -0.8154 |
| ANCASH | 8.603 | 8.436 | 8.772 | 8.465 | 6.09 | 6.15 | 2.315 |
| APURIMAC | 8.542 | 8.28 | 8.812 | 7.672 | 6.76 | 6.61 | 1.062 |
| AREQUIPA | 8.994 | 8.835 | 9.154 | 8.145 | 5.53 | 5.8 | 2.345 |
| AYACUCHO | 7.149 | 6.956 | 7.346 | 6.191 | 6.15 | 5.91 | 0.2806 |
| CAJAMARCA | 9.72 | 9.565 | 9.877 | 7.43 | 5.39 | 5.5 | 1.93 |
| CALLAO | 10.3 | 10.11 | 10.49 | 9.803 | 4.91 | 5.27 | 4.533 |
| CUSCO | 7.03 | 6.889 | 7.173 | 6.809 | 6.88 | 6.97 | -0.1608 |
| HUANCAVELICA | 6.309 | 6.093 | 6.531 | 8.442 | 5.83 | 5.54 | 2.902 |
| HUANUCO | 7.538 | 7.359 | 7.721 | 7.776 | 5.94 | 5.98 | 1.796 |
| ICA | 9.45 | 9.241 | 9.662 | 7.995 | 4.99 | 5.29 | 2.705 |
| JUNIN | 7.409 | 7.267 | 7.553 | 7.442 | 6.17 | 6.24 | 1.202 |
| LA LIBERTAD | 7.951 | 7.827 | 8.077 | 7.636 | 5.24 | 5.39 | 2.246 |
| LAMBAYEQUE | 4.439 | 4.326 | 4.555 | 4.429 | 5.25 | 5.55 | -1.121 |
| LIMA | 13.86 | 13.79 | 13.93 | 12.85 | 5.13 | 5.4 | 7.455 |
| LORETO | 8.75 | 8.574 | 8.927 | 8.275 | 4.92 | 5.07 | 3.205 |
| MADRE DE DIOS | 7.123 | 6.706 | 7.558 | 6.276 | 4.4 | 4.54 | 1.736 |
| MOQUEGUA | 9.84 | 9.398 | 10.3 | 9.555 | 5.49 | 5.86 | 3.695 |
| PASCO | 9.104 | 8.774 | 9.444 | 7.915 | 5.54 | 5.54 | 2.375 |
| PIURA | 11.96 | 11.81 | 12.12 | 10.28 | 5.36 | 5.5 | 4.779 |
| PUNO | 7.595 | 7.455 | 7.736 | 8.283 | 7.01 | 6.86 | 1.423 |
| SAN MARTIN | 8.853 | 8.659 | 9.05 | 7.741 | 5.47 | 5.63 | 2.111 |
| TACNA | 6.12 | 5.868 | 6.38 | 5.832 | 5.09 | 5.4 | 0.4319 |
| TUMBES | 8.322 | 7.969 | 8.686 | 8.233 | 4.7 | 4.94 | 3.293 |
| UCAYALI | 9.722 | 9.457 | 9.993 | 8.077 | 5.68 | 5.93 | 2.147 |

### Counterfacutual and total deaths 2020

Table 5: Counterfacutual and total deaths 2020

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Departamento | range | sinadef | excess.T | excess.l | excess.u | excess.reg | excess.reg.l | excess.reg.u | count | count.l | count.u | total | total.l | total.u |
| AMAZONAS | a0.9 | 60 | 0 | -0.9702 | -0.9702 | 0 | 0 | 0 | 60 | 60 | 60 | 178.2 | 177.2 | 177.2 |
| AMAZONAS | a10.19 | 22 | 0 | -0.9702 | -0.9702 | 0 | 0 | 0 | 22 | 22 | 22 | 65.35 | 64.37 | 64.37 |
| AMAZONAS | a20.29 | 36 | 5 | 5 | 5 | 0 | 0 | 0 | 36 | 36 | 36 | 111.9 | 111.9 | 111.9 |
| AMAZONAS | a30.39 | 60 | 11 | 11 | 11 | 0 | 0 | 0 | 60 | 60 | 60 | 189.2 | 189.2 | 189.2 |
| AMAZONAS | a40.49 | 83 | 15 | 15 | 15 | 0 | 0 | 0 | 83 | 83 | 83 | 261.5 | 261.5 | 261.5 |
| AMAZONAS | a50.59 | 123 | 179.3 | 40 | 220.1 | 60.35 | 31.66 | 74.43 | 62.65 | 48.57 | 91.34 | 365.3 | 184.3 | 491.4 |
| AMAZONAS | a60.69 | 199 | 333.6 | 236.7 | 381.6 | 112.3 | 80 | 128.8 | 86.68 | 70.18 | 119 | 591.1 | 445.1 | 735.1 |
| AMAZONAS | a70.79 | 199 | 272.7 | 62 | 329.3 | 91.81 | 57.84 | 111.2 | 107.2 | 87.8 | 141.2 | 591.1 | 322.8 | 748.6 |
| AMAZONAS | a80 | 337 | 56 | 56 | 56 | 0 | 0 | 0 | 337 | 337 | 337 | 1057 | 1057 | 1057 |
| ANCASH | a0.9 | 242 | 3 | 3 | 3 | 0 | 0 | 0 | 242 | 242 | 242 | 287.3 | 287.3 | 287.3 |
| ANCASH | a10.19 | 101 | 2 | 2 | 2 | 0 | 0 | 0 | 101 | 101 | 101 | 120.7 | 120.7 | 120.7 |
| ANCASH | a20.29 | 163 | 12 | 12 | 12 | 0 | 0 | 0 | 163 | 163 | 163 | 203.5 | 203.5 | 203.5 |
| ANCASH | a30.39 | 224 | 37 | 37 | 37 | 0 | 0 | 0 | 224 | 224 | 224 | 300.2 | 300.2 | 300.2 |
| ANCASH | a40.49 | 472 | 306.3 | 240 | 352.6 | 260.8 | 203.6 | 299.4 | 211.2 | 172.6 | 268.4 | 554.5 | 442.8 | 667.9 |
| ANCASH | a50.59 | 891 | 673.9 | 585.3 | 738.7 | 573.6 | 497.5 | 628.1 | 317.4 | 262.9 | 393.5 | 1047 | 894.2 | 1201 |
| ANCASH | a60.69 | 1392 | 1031 | 920.3 | 1117 | 877.5 | 782.6 | 949.7 | 514.5 | 442.3 | 609.4 | 1635 | 1440 | 1833 |
| ANCASH | a70.79 | 1956 | 1227 | 1060 | 1361 | 1044 | 901.9 | 1158 | 912 | 798.5 | 1054 | 2298 | 1999 | 2599 |
| ANCASH | a80 | 3132 | 862.7 | 547.6 | 1133 | 734.3 | 465.4 | 963.9 | 2398 | 2168 | 2667 | 3680 | 3095 | 4266 |
| APURIMAC | a0.9 | 100 | 2 | 2 | 2 | 0 | 0 | 0 | 100 | 100 | 100 | 177.4 | 177.4 | 177.4 |
| APURIMAC | a10.19 | 51 | 3 | 3 | 3 | 0 | 0 | 0 | 51 | 51 | 51 | 92.47 | 92.47 | 92.47 |
| APURIMAC | a20.29 | 64 | 59.95 | 26.65 | 73.01 | 34.17 | 15.05 | 41.48 | 29.83 | 22.52 | 48.95 | 112.3 | 66.16 | 158.9 |
| APURIMAC | a30.39 | 73 | 49.6 | 5 | 68.79 | 28.28 | 2.767 | 39.07 | 44.72 | 33.93 | 70.23 | 128.1 | 64.51 | 192 |
| APURIMAC | a40.49 | 119 | 11 | 11 | 11 | 0 | 0 | 0 | 119 | 119 | 119 | 219.8 | 219.8 | 219.8 |
| APURIMAC | a50.59 | 200 | 26 | 26 | 26 | 0 | 0 | 0 | 200 | 200 | 200 | 376.9 | 376.9 | 376.9 |
| APURIMAC | a60.69 | 275 | 25 | 25 | 25 | 0 | 0 | 0 | 275 | 275 | 275 | 507.4 | 507.4 | 507.4 |
| APURIMAC | a70.79 | 448 | 39 | 39 | 39 | 0 | 0 | 0 | 448 | 448 | 448 | 824.9 | 824.9 | 824.9 |
| APURIMAC | a80 | 862 | 44 | 44 | 44 | 0 | 0 | 0 | 862 | 862 | 862 | 1556 | 1556 | 1556 |
| AREQUIPA | a0.9 | 216 | 4 | 4 | 4 | 0 | 0 | 0 | 216 | 216 | 216 | 231.9 | 231.9 | 231.9 |
| AREQUIPA | a10.19 | 98 | 8 | 8 | 8 | 0 | 0 | 0 | 98 | 98 | 98 | 111.4 | 111.4 | 111.4 |
| AREQUIPA | a20.29 | 232 | 12 | 12 | 12 | 0 | 0 | 0 | 232 | 232 | 232 | 256.8 | 256.8 | 256.8 |
| AREQUIPA | a30.39 | 329 | 29 | 29 | 29 | 0 | 0 | 0 | 329 | 329 | 329 | 376.1 | 376.1 | 376.1 |
| AREQUIPA | a40.49 | 662 | 343 | 259.7 | 401.9 | 325.1 | 245.3 | 380 | 336.9 | 282 | 416.7 | 698.4 | 557.2 | 841.5 |
| AREQUIPA | a50.59 | 1214 | 764.2 | 667.1 | 835.5 | 724.3 | 631.4 | 791 | 489.7 | 423 | 582.6 | 1281 | 1113 | 1450 |
| AREQUIPA | a60.69 | 1991 | 1226 | 1080 | 1338 | 1162 | 1023 | 1268 | 829.1 | 723.4 | 968.2 | 2101 | 1843 | 2360 |
| AREQUIPA | a70.79 | 2479 | 1352 | 1178 | 1491 | 1281 | 1115 | 1412 | 1198 | 1067 | 1364 | 2615 | 2303 | 2930 |
| AREQUIPA | a80 | 4306 | 1878 | 1635 | 2087 | 1780 | 1549 | 1978 | 2526 | 2328 | 2757 | 4543 | 4092 | 4996 |
| AYACUCHO | a0.9 | 122 | 1 | 1 | 1 | 0 | 0 | 0 | 122 | 122 | 122 | 242.4 | 242.4 | 242.4 |
| AYACUCHO | a10.19 | 62 | 3 | 3 | 3 | 0 | 0 | 0 | 62 | 62 | 62 | 125.7 | 125.7 | 125.7 |
| AYACUCHO | a20.29 | 95 | 3 | 3 | 3 | 0 | 0 | 0 | 95 | 95 | 95 | 191 | 191 | 191 |
| AYACUCHO | a30.39 | 100 | 11 | 11 | 11 | 0 | 0 | 0 | 100 | 100 | 100 | 208.9 | 208.9 | 208.9 |
| AYACUCHO | a40.49 | 161 | 24 | 24 | 24 | 0 | 0 | 0 | 161 | 161 | 161 | 342.5 | 342.5 | 342.5 |
| AYACUCHO | a50.59 | 214 | 50 | 50 | 50 | 0 | 0 | 0 | 214 | 214 | 214 | 473.4 | 473.4 | 473.4 |
| AYACUCHO | a60.69 | 373 | 100 | 100 | 100 | 0 | 0 | 0 | 373 | 373 | 373 | 838 | 838 | 838 |
| AYACUCHO | a70.79 | 554 | 340.7 | 105 | 447.2 | 172.2 | 96.67 | 226 | 381.8 | 328 | 457.3 | 1096 | 754 | 1352 |
| AYACUCHO | a80 | 844 | 357.8 | 167.3 | 505.9 | 180.8 | 84.53 | 255.7 | 663.2 | 588.3 | 759.5 | 1670 | 1331 | 2009 |
| CAJAMARCA | a0.9 | 231 | 2 | 2 | 2 | 0 | 0 | 0 | 231 | 231 | 231 | 681.4 | 681.4 | 681.4 |
| CAJAMARCA | a10.19 | 75 | 3 | 3 | 3 | 0 | 0 | 0 | 75 | 75 | 75 | 223.6 | 223.6 | 223.6 |
| CAJAMARCA | a20.29 | 128 | 6 | 6 | 6 | 0 | 0 | 0 | 128 | 128 | 128 | 382.5 | 382.5 | 382.5 |
| CAJAMARCA | a30.39 | 207 | 24 | 24 | 24 | 0 | 0 | 0 | 207 | 207 | 207 | 632.8 | 632.8 | 632.8 |
| CAJAMARCA | a40.49 | 294 | 265.9 | 47 | 378.7 | 90.39 | 31.22 | 129.1 | 203.6 | 164.9 | 262.8 | 864.7 | 532.1 | 1152 |
| CAJAMARCA | a50.59 | 539 | 875.5 | 717.4 | 979.1 | 297.7 | 244.2 | 333.2 | 241.3 | 205.8 | 294.8 | 1585 | 1323 | 1846 |
| CAJAMARCA | a60.69 | 793 | 1436 | 1241 | 1568 | 488.3 | 422.1 | 533.5 | 304.7 | 259.5 | 370.9 | 2332 | 2004 | 2659 |
| CAJAMARCA | a70.79 | 1072 | 1319 | 1004 | 1552 | 448.4 | 341.8 | 528 | 623.6 | 544 | 730.2 | 3153 | 2604 | 3700 |
| CAJAMARCA | a80 | 1753 | 1414 | 967.5 | 1778 | 480.8 | 329.3 | 604.9 | 1272 | 1148 | 1424 | 5156 | 4344 | 5966 |
| CALLAO | a0.9 | 156 | 3 | 3 | 3 | 0 | 0 | 0 | 156 | 156 | 156 | 181.8 | 181.8 | 181.8 |
| CALLAO | a10.19 | 49 | 1 | 1 | 1 | 0 | 0 | 0 | 49 | 49 | 49 | 57.17 | 57.17 | 57.17 |
| CALLAO | a20.29 | 185 | 15 | 15 | 15 | 0 | 0 | 0 | 185 | 185 | 185 | 227.1 | 227.1 | 227.1 |
| CALLAO | a30.39 | 319 | 167.8 | 99.86 | 212 | 146.4 | 86.37 | 184.1 | 172.6 | 134.9 | 232.6 | 365.7 | 254.5 | 478.6 |
| CALLAO | a40.49 | 637 | 565.5 | 523.7 | 594.5 | 493.3 | 456.1 | 517.9 | 143.7 | 119.1 | 180.9 | 730.2 | 660.3 | 801.9 |
| CALLAO | a50.59 | 1192 | 1053 | 985.5 | 1102 | 918.6 | 858.9 | 960.3 | 273.4 | 231.7 | 333.1 | 1366 | 1251 | 1484 |
| CALLAO | a60.69 | 1960 | 1739 | 1654 | 1804 | 1517 | 1442 | 1573 | 442.7 | 387.1 | 518.1 | 2247 | 2097 | 2398 |
| CALLAO | a70.79 | 2221 | 1841 | 1729 | 1931 | 1606 | 1507 | 1683 | 614.7 | 537.7 | 713.8 | 2546 | 2345 | 2749 |
| CALLAO | a80 | 2983 | 1757 | 1525 | 1948 | 1533 | 1330 | 1699 | 1450 | 1284 | 1653 | 3420 | 2998 | 3843 |
| CUSCO | a0.9 | 353 | 4 | 4 | 4 | 0 | 0 | 0 | 353 | 353 | 353 | 441 | 441 | 441 |
| CUSCO | a10.19 | 178 | 44.71 | 3 | 71.31 | 36.12 | 2.054 | 56.99 | 141.9 | 121 | 175.9 | 220.4 | 152.8 | 289.1 |
| CUSCO | a20.29 | 247 | 8 | 8 | 8 | 0 | 0 | 0 | 247 | 247 | 247 | 313.8 | 313.8 | 313.8 |
| CUSCO | a30.39 | 319 | 18 | 18 | 18 | 0 | 0 | 0 | 319 | 319 | 319 | 412.9 | 412.9 | 412.9 |
| CUSCO | a40.49 | 519 | 152.3 | 50.37 | 223.7 | 123 | 40.07 | 180.1 | 396 | 338.9 | 478.9 | 642.5 | 469.9 | 816.6 |
| CUSCO | a50.59 | 788 | 288 | 189.7 | 362 | 232.6 | 152.6 | 291.8 | 555.4 | 496.2 | 635.4 | 975.5 | 804 | 1149 |
| CUSCO | a60.69 | 1192 | 510.4 | 379.5 | 610.4 | 412.3 | 306 | 492.5 | 779.7 | 699.5 | 886 | 1476 | 1246 | 1707 |
| CUSCO | a70.79 | 1610 | 551.4 | 410.6 | 666.7 | 445.4 | 331 | 537.9 | 1165 | 1072 | 1279 | 1993 | 1738 | 2250 |
| CUSCO | a80 | 2450 | 695.6 | 503 | 859.1 | 561.9 | 405.7 | 693.4 | 1888 | 1757 | 2044 | 3033 | 2678 | 3390 |
| HUANCAVELICA | a0.9 | 142 | 1 | 1 | 1 | 0 | 0 | 0 | 142 | 142 | 142 | 183.7 | 183.7 | 183.7 |
| HUANCAVELICA | a10.19 | 60 | 2 | 2 | 2 | 0 | 0 | 0 | 60 | 60 | 60 | 79.2 | 79.2 | 79.2 |
| HUANCAVELICA | a20.29 | 76 | 2 | 2 | 2 | 0 | 0 | 0 | 76 | 76 | 76 | 99.78 | 99.78 | 99.78 |
| HUANCAVELICA | a30.39 | 79 | 7 | 7 | 7 | 0 | 0 | 0 | 79 | 79 | 79 | 108.6 | 108.6 | 108.6 |
| HUANCAVELICA | a40.49 | 152 | 19 | 19 | 19 | 0 | 0 | 0 | 152 | 152 | 152 | 214.6 | 214.6 | 214.6 |
| HUANCAVELICA | a50.59 | 232 | 18 | 18 | 18 | 0 | 0 | 0 | 232 | 232 | 232 | 316.5 | 316.5 | 316.5 |
| HUANCAVELICA | a60.69 | 354 | 40 | 40 | 40 | 0 | 0 | 0 | 354 | 354 | 354 | 495.5 | 495.5 | 495.5 |
| HUANCAVELICA | a70.79 | 548 | 197.8 | 99.97 | 267.1 | 153.7 | 77.14 | 207.1 | 394.3 | 340.9 | 470.9 | 705.1 | 538.6 | 873 |
| HUANCAVELICA | a80 | 782 | 20 | 20 | 20 | 0 | 0 | 0 | 782 | 782 | 782 | 1026 | 1026 | 1026 |
| HUANUCO | a0.9 | 187 | 0 | 0.3497 | 0.3497 | 0 | 0 | 0 | 187 | 187 | 187 | 308.6 | 309 | 309 |
| HUANUCO | a10.19 | 71 | 4 | 4 | 4 | 0 | 0 | 0 | 71 | 71 | 71 | 121.2 | 121.2 | 121.2 |
| HUANUCO | a20.29 | 125 | 74.76 | 22.83 | 103.9 | 45.3 | 13.62 | 62.72 | 79.7 | 62.28 | 111.4 | 206.3 | 125.6 | 287.7 |
| HUANUCO | a30.39 | 166 | 93.11 | 18 | 138.4 | 56.42 | 7.024 | 83.63 | 109.6 | 82.37 | 159 | 274 | 153.9 | 400.7 |
| HUANUCO | a40.49 | 267 | 34 | 34 | 34 | 0 | 0 | 0 | 267 | 267 | 267 | 474.6 | 474.6 | 474.6 |
| HUANUCO | a50.59 | 411 | 240.3 | 82 | 320.6 | 145.6 | 70.56 | 194 | 265.4 | 217 | 340.4 | 678.3 | 440.1 | 882.4 |
| HUANUCO | a60.69 | 670 | 321.7 | 114 | 447.6 | 194.9 | 89.49 | 271 | 475.1 | 399 | 580.5 | 1106 | 772.5 | 1406 |
| HUANUCO | a70.79 | 908 | 441 | 260.4 | 578.7 | 267.2 | 157.6 | 350.5 | 640.8 | 557.5 | 750.4 | 1498 | 1181 | 1817 |
| HUANUCO | a80 | 1232 | 413.8 | 103 | 608.7 | 250.8 | 101.9 | 368.6 | 981.2 | 863.4 | 1130 | 2033 | 1528 | 2474 |
| ICA | a0.9 | 170 | 3 | 3 | 3 | 0 | 0 | 0 | 170 | 170 | 170 | 173.2 | 173.2 | 173.2 |
| ICA | a10.19 | 52 | 2 | 2 | 2 | 0 | 0 | 0 | 52 | 52 | 52 | 54.08 | 54.08 | 54.08 |
| ICA | a20.29 | 164 | 15 | 15 | 15 | 0 | 0 | 0 | 164 | 164 | 164 | 179.2 | 179.2 | 179.2 |
| ICA | a30.39 | 256 | 113.8 | 58.79 | 147.3 | 113.6 | 57.7 | 146.1 | 142.4 | 109.9 | 198.3 | 256.4 | 168.9 | 345.9 |
| ICA | a40.49 | 527 | 307.3 | 239 | 352.9 | 306.8 | 237.6 | 351.4 | 220.2 | 175.6 | 289.4 | 527.8 | 414.8 | 642.7 |
| ICA | a50.59 | 968 | 626.7 | 554.6 | 679.7 | 625.8 | 552.8 | 677.7 | 342.2 | 290.3 | 415.2 | 969.4 | 845.3 | 1095 |
| ICA | a60.69 | 1468 | 1060 | 978 | 1121 | 1058 | 975.6 | 1119 | 409.8 | 349.5 | 492.4 | 1470 | 1328 | 1614 |
| ICA | a70.79 | 1639 | 922.7 | 808.6 | 1013 | 921.3 | 806.4 | 1011 | 717.7 | 628.2 | 832.6 | 1641 | 1438 | 1847 |
| ICA | a80 | 2521 | 1202 | 1032 | 1344 | 1200 | 1029 | 1341 | 1321 | 1180 | 1492 | 2525 | 2214 | 2838 |
| JUNIN | a0.9 | 371 | 7 | 7 | 7 | 0 | 0 | 0 | 371 | 371 | 371 | 457.9 | 457.9 | 457.9 |
| JUNIN | a10.19 | 151 | 5 | 5 | 5 | 0 | 0 | 0 | 151 | 151 | 151 | 188.5 | 188.5 | 188.5 |
| JUNIN | a20.29 | 219 | 14 | 14 | 14 | 0 | 0 | 0 | 219 | 219 | 219 | 280.2 | 280.2 | 280.2 |
| JUNIN | a30.39 | 322 | 99.29 | 26 | 152.9 | 81.69 | 14.17 | 125.2 | 240.3 | 196.8 | 307.8 | 391.3 | 265.2 | 527.1 |
| JUNIN | a40.49 | 552 | 273.9 | 177.6 | 341 | 225.4 | 145.5 | 279.9 | 326.6 | 272.1 | 406.5 | 670.9 | 508.2 | 835.1 |
| JUNIN | a50.59 | 947 | 557.6 | 446.4 | 639.1 | 458.8 | 366.6 | 525.2 | 488.2 | 421.8 | 580.4 | 1151 | 959.1 | 1344 |
| JUNIN | a60.69 | 1393 | 801.7 | 662.7 | 908 | 659.6 | 544.6 | 746.4 | 733.4 | 646.6 | 848.4 | 1693 | 1448 | 1939 |
| JUNIN | a70.79 | 1803 | 639.3 | 448.1 | 795.8 | 526 | 368 | 654.2 | 1277 | 1149 | 1435 | 2191 | 1844 | 2540 |
| JUNIN | a80 | 2745 | 698.1 | 468.1 | 895.8 | 574.4 | 384.5 | 736.4 | 2171 | 2009 | 2360 | 3336 | 2909 | 3765 |
| LA LIBERTAD | a0.9 | 333 | 5 | 5 | 5 | 0 | 0 | 0 | 333 | 333 | 333 | 419.1 | 419.1 | 419.1 |
| LA LIBERTAD | a10.19 | 142 | 67.96 | 22.9 | 92.94 | 54.64 | 17.8 | 74.13 | 87.36 | 67.87 | 124.2 | 176.6 | 107.3 | 247.4 |
| LA LIBERTAD | a20.29 | 297 | 123.5 | 50.79 | 170.5 | 99.3 | 40.23 | 136.5 | 197.7 | 160.5 | 256.8 | 369.4 | 250.4 | 489.9 |
| LA LIBERTAD | a30.39 | 409 | 220.9 | 157 | 265.7 | 177.6 | 125.6 | 213 | 231.4 | 196 | 283.4 | 508.7 | 400.7 | 618.1 |
| LA LIBERTAD | a40.49 | 743 | 549.4 | 485.9 | 597.1 | 441.7 | 390.1 | 479.5 | 301.3 | 263.5 | 352.9 | 924.1 | 813.6 | 1036 |
| LA LIBERTAD | a50.59 | 1441 | 1076 | 951.9 | 1168 | 865.1 | 764.8 | 938.9 | 575.9 | 502.1 | 676.2 | 1792 | 1576 | 2009 |
| LA LIBERTAD | a60.69 | 2321 | 1791 | 1641 | 1908 | 1440 | 1319 | 1534 | 881.1 | 787.2 | 1002 | 2887 | 2620 | 3155 |
| LA LIBERTAD | a70.79 | 2872 | 2075 | 1903 | 2215 | 1668 | 1529 | 1780 | 1204 | 1092 | 1343 | 3572 | 3261 | 3885 |
| LA LIBERTAD | a80 | 4055 | 2183 | 1935 | 2396 | 1755 | 1555 | 1926 | 2300 | 2129 | 2500 | 5043 | 4583 | 5505 |
| LAMBAYEQUE | a0.9 | 81 | 3 | 3 | 3 | 0 | 0 | 0 | 81 | 81 | 81 | 93.08 | 93.08 | 93.08 |
| LAMBAYEQUE | a10.19 | 29 | 2 | 2 | 2 | 0 | 0 | 0 | 29 | 29 | 29 | 34.25 | 34.25 | 34.25 |
| LAMBAYEQUE | a20.29 | 90 | 25 | 25 | 25 | 0 | 0 | 0 | 90 | 90 | 90 | 125.1 | 125.1 | 125.1 |
| LAMBAYEQUE | a30.39 | 175 | 144.6 | 121.3 | 157.4 | 130 | 108.3 | 140.7 | 44.98 | 34.3 | 66.71 | 194.6 | 159.5 | 231.5 |
| LAMBAYEQUE | a40.49 | 368 | 370.2 | 357.2 | 377.6 | 332.9 | 320.4 | 338.8 | 35.11 | 29.24 | 47.55 | 409.2 | 389.8 | 430.5 |
| LAMBAYEQUE | a50.59 | 734 | 751 | 732.4 | 762.2 | 675.3 | 657.8 | 684.6 | 58.7 | 49.44 | 76.2 | 816.3 | 787.4 | 846.9 |
| LAMBAYEQUE | a60.69 | 1230 | 1267 | 1244 | 1282 | 1140 | 1117 | 1152 | 90.42 | 77.99 | 112.5 | 1368 | 1330 | 1407 |
| LAMBAYEQUE | a70.79 | 1194 | 1215 | 1190 | 1232 | 1093 | 1069 | 1107 | 101.2 | 86.86 | 125 | 1328 | 1286 | 1371 |
| LAMBAYEQUE | a80 | 1300 | 1186 | 1108 | 1233 | 1067 | 995.5 | 1108 | 233.5 | 191.9 | 304.5 | 1446 | 1321 | 1572 |
| LIMA | a0.9 | 1374 | 47 | 47 | 47 | 0 | 0 | 0 | 1374 | 1374 | 1374 | 2413 | 2413 | 2413 |
| LIMA | a10.19 | 483 | 36 | 36 | 36 | 0 | 0 | 0 | 483 | 483 | 483 | 867.8 | 867.8 | 867.8 |
| LIMA | a20.29 | 1295 | 694.8 | 401.1 | 923.1 | 403.5 | 232.8 | 535.9 | 891.5 | 759.1 | 1062 | 2230 | 1708 | 2752 |
| LIMA | a30.39 | 2632 | 2089 | 1762 | 2361 | 1213 | 1023 | 1371 | 1419 | 1261 | 1609 | 4533 | 3933 | 5133 |
| LIMA | a40.49 | 5416 | 6640 | 6334 | 6896 | 3856 | 3678 | 4005 | 1560 | 1411 | 1738 | 9327 | 8765 | 9890 |
| LIMA | a50.59 | 10547 | 13506 | 12937 | 13978 | 7843 | 7512 | 8117 | 2704 | 2430 | 3035 | 18163 | 17122 | 19204 |
| LIMA | a60.69 | 17130 | 21955 | 21080 | 22689 | 12749 | 12241 | 13175 | 4381 | 3955 | 4889 | 29500 | 27891 | 31109 |
| LIMA | a70.79 | 19325 | 22035 | 20863 | 23041 | 12795 | 12114 | 13379 | 6530 | 5946 | 7211 | 33280 | 31102 | 35458 |
| LIMA | a80 | 27136 | 20779 | 18835 | 22531 | 12066 | 10937 | 13083 | 15070 | 14053 | 16199 | 46731 | 43034 | 50428 |
| LORETO | a0.9 | 275 | 6 | 6 | 6 | 0 | 0 | 0 | 275 | 275 | 275 | 591.2 | 591.2 | 591.2 |
| LORETO | a10.19 | 85 | 11 | 11 | 11 | 0 | 0 | 0 | 85 | 85 | 85 | 191.9 | 191.9 | 191.9 |
| LORETO | a20.29 | 152 | 20 | 20 | 20 | 0 | 0 | 0 | 152 | 152 | 152 | 343.5 | 343.5 | 343.5 |
| LORETO | a30.39 | 255 | 225.9 | 49 | 301.2 | 106.2 | 47.66 | 141.6 | 148.8 | 113.4 | 207.3 | 542.7 | 290.3 | 742.4 |
| LORETO | a40.49 | 389 | 533.3 | 448.9 | 587.6 | 250.6 | 211 | 276.2 | 138.4 | 112.8 | 178 | 827.8 | 689 | 966.4 |
| LORETO | a50.59 | 615 | 951.2 | 860.1 | 1010 | 447 | 404.2 | 474.8 | 168 | 140.2 | 210.8 | 1309 | 1158 | 1459 |
| LORETO | a60.69 | 957 | 1618 | 1521 | 1679 | 760.3 | 714.9 | 789 | 196.7 | 168 | 242.1 | 2037 | 1879 | 2194 |
| LORETO | a70.79 | 933 | 1519 | 1408 | 1592 | 714 | 661.6 | 748.1 | 219 | 184.9 | 271.4 | 1986 | 1801 | 2170 |
| LORETO | a80 | 784 | 1077 | 927.6 | 1179 | 506.1 | 435.9 | 554 | 277.9 | 230 | 348.1 | 1668 | 1417 | 1920 |
| MADRE DE DIOS | a0.9 | 92 | 2 | 2 | 2 | 0 | 0 | 0 | 92 | 92 | 92 | 94.76 | 94.76 | 94.76 |
| MADRE DE DIOS | a10.19 | 21 | 0 | 0.9917 | 0.9917 | 0 | 0 | 0 | 21 | 21 | 21 | 21.17 | 22.17 | 22.17 |
| MADRE DE DIOS | a20.29 | 79 | 2 | 2 | 2 | 0 | 0 | 0 | 79 | 79 | 79 | 81.66 | 81.66 | 81.66 |
| MADRE DE DIOS | a30.39 | 92 | 39.39 | 7 | 56.69 | 39.06 | 0.6504 | 55.24 | 52.94 | 36.76 | 91.35 | 92.76 | 44.07 | 148.8 |
| MADRE DE DIOS | a40.49 | 117 | 49.67 | 22 | 71.01 | 49.27 | 4.504 | 69.44 | 67.73 | 47.56 | 112.5 | 118 | 69.95 | 184.4 |
| MADRE DE DIOS | a50.59 | 172 | 108.4 | 78.28 | 124.4 | 107.5 | 76.65 | 122.3 | 64.47 | 49.66 | 95.35 | 173.4 | 128.4 | 220.5 |
| MADRE DE DIOS | a60.69 | 191 | 130.5 | 107.2 | 143.5 | 129.4 | 105.3 | 141.3 | 61.58 | 49.66 | 85.66 | 192.6 | 157.3 | 229.9 |
| MADRE DE DIOS | a70.79 | 168 | 80.79 | 38.71 | 104.5 | 80.13 | 37.41 | 102.7 | 87.87 | 65.3 | 130.6 | 169.4 | 104.5 | 236.2 |
| MADRE DE DIOS | a80 | 146 | 87.06 | 61.18 | 101.5 | 86.34 | 59.69 | 99.67 | 59.66 | 46.33 | 86.31 | 147.2 | 107.9 | 188.5 |
| MOQUEGUA | a0.9 | 21 | 2 | 2 | 2 | 0 | 0 | 0 | 21 | 21 | 21 | 27.57 | 27.57 | 27.57 |
| MOQUEGUA | a10.19 | 10 | 1 | 1 | 1 | 0 | 0 | 0 | 10 | 10 | 10 | 13.18 | 13.18 | 13.18 |
| MOQUEGUA | a20.29 | 39 | 2 | 2 | 2 | 0 | 0 | 0 | 39 | 39 | 39 | 49.48 | 49.48 | 49.48 |
| MOQUEGUA | a30.39 | 33 | 25.2 | 13.97 | 29 | 20.7 | 10.83 | 23.17 | 12.3 | 9.826 | 22.17 | 40.18 | 25.93 | 55.99 |
| MOQUEGUA | a40.49 | 90 | 69.27 | 48.93 | 77.83 | 56.9 | 39.55 | 63.28 | 33.1 | 26.72 | 50.45 | 109.6 | 81.46 | 139.3 |
| MOQUEGUA | a50.59 | 173 | 150.6 | 122 | 164.1 | 123.7 | 99.57 | 134.1 | 49.31 | 38.9 | 73.43 | 210.6 | 169.4 | 253.5 |
| MOQUEGUA | a60.69 | 277 | 253.4 | 225.6 | 268.9 | 208.1 | 184.6 | 220.2 | 68.85 | 56.77 | 92.39 | 337.2 | 294.7 | 381.4 |
| MOQUEGUA | a70.79 | 380 | 316.3 | 274.2 | 341.4 | 259.8 | 224.6 | 279.8 | 120.2 | 100.2 | 155.4 | 462.7 | 396.2 | 530.7 |
| MOQUEGUA | a80 | 506 | 267.2 | 194.2 | 318.6 | 219.5 | 158.8 | 261 | 286.5 | 245 | 347.2 | 616.1 | 492.4 | 741.3 |
| PASCO | a0.9 | 91 | 1 | 1 | 1 | 0 | 0 | 0 | 91 | 91 | 91 | 211.8 | 211.8 | 211.8 |
| PASCO | a10.19 | 28 | 1 | 1 | 1 | 0 | 0 | 0 | 28 | 28 | 28 | 65.86 | 65.86 | 65.86 |
| PASCO | a20.29 | 45 | 5 | 5 | 5 | 0 | 0 | 0 | 45 | 45 | 45 | 109.2 | 109.2 | 109.2 |
| PASCO | a30.39 | 58 | 5 | 5 | 5 | 0 | 0 | 0 | 58 | 58 | 58 | 139.3 | 139.3 | 139.3 |
| PASCO | a40.49 | 83 | 11 | 11 | 11 | 0 | 0 | 0 | 83 | 83 | 83 | 203.2 | 203.2 | 203.2 |
| PASCO | a50.59 | 152 | 156.3 | 26 | 218.2 | 67.47 | 12.48 | 94.34 | 84.53 | 57.66 | 139.5 | 352.1 | 159.6 | 541.4 |
| PASCO | a60.69 | 219 | 223.5 | 38 | 304.8 | 96.51 | 30.51 | 131.7 | 122.5 | 87.28 | 188.5 | 507.3 | 240.2 | 741.4 |
| PASCO | a70.79 | 245 | 225.1 | 57.36 | 318 | 97.17 | 24.9 | 137.4 | 147.8 | 107.6 | 220.1 | 567.5 | 306.6 | 827.8 |
| PASCO | a80 | 293 | 30 | 30 | 30 | 0 | 0 | 0 | 293 | 293 | 293 | 708.7 | 708.7 | 708.7 |
| PIURA | a0.9 | 301 | 18 | 18 | 18 | 0 | 0 | 0 | 301 | 301 | 301 | 626.5 | 626.5 | 626.5 |
| PIURA | a10.19 | 92 | 9 | 9 | 9 | 0 | 0 | 0 | 92 | 92 | 92 | 195 | 195 | 195 |
| PIURA | a20.29 | 218 | 171.6 | 54.23 | 241.4 | 84.89 | 26.83 | 119.4 | 133.1 | 98.6 | 191.2 | 440.7 | 253.6 | 627.9 |
| PIURA | a30.39 | 362 | 435 | 335.7 | 498.6 | 215.1 | 166.1 | 246.6 | 146.9 | 115.4 | 195.9 | 731.9 | 569 | 894.7 |
| PIURA | a40.49 | 744 | 1184 | 1107 | 1234 | 585.4 | 547.4 | 610.4 | 158.6 | 133.6 | 196.6 | 1504 | 1377 | 1631 |
| PIURA | a50.59 | 1385 | 2233 | 2142 | 2301 | 1105 | 1060 | 1138 | 280.4 | 246.7 | 325.4 | 2800 | 2641 | 2959 |
| PIURA | a60.69 | 2447 | 3814 | 3600 | 3973 | 1886 | 1781 | 1965 | 560.6 | 481.9 | 666.1 | 4947 | 4575 | 5320 |
| PIURA | a70.79 | 2513 | 3745 | 3557 | 3892 | 1852 | 1759 | 1925 | 660.7 | 588.1 | 753.6 | 5081 | 4746 | 5415 |
| PIURA | a80 | 3251 | 4052 | 3752 | 4298 | 2004 | 1856 | 2126 | 1247 | 1125 | 1395 | 6573 | 6026 | 7119 |
| PUNO | a0.9 | 290 | 76.9 | 7.824 | 125.7 | 47.88 | 4.626 | 77.99 | 242.1 | 212 | 285.4 | 465.8 | 348.3 | 584 |
| PUNO | a10.19 | 129 | 2 | 2 | 2 | 0 | 0 | 0 | 129 | 129 | 129 | 209.2 | 209.2 | 209.2 |
| PUNO | a20.29 | 230 | 12 | 12 | 12 | 0 | 0 | 0 | 230 | 230 | 230 | 381.4 | 381.4 | 381.4 |
| PUNO | a30.39 | 282 | 107 | 26.45 | 156.6 | 66.6 | 16.22 | 97.27 | 215.4 | 184.7 | 265.8 | 452.9 | 323.1 | 583.5 |
| PUNO | a40.49 | 486 | 321.3 | 251.3 | 370.7 | 200.1 | 156.2 | 230.6 | 285.9 | 255.4 | 329.8 | 780.6 | 661.6 | 900.4 |
| PUNO | a50.59 | 788 | 516.6 | 395.3 | 603.6 | 321.6 | 245.9 | 375.6 | 466.4 | 412.4 | 542.1 | 1266 | 1058 | 1474 |
| PUNO | a60.69 | 1128 | 872.5 | 753.4 | 962.9 | 543.2 | 468.9 | 599.3 | 584.8 | 528.7 | 659.1 | 1812 | 1603 | 2022 |
| PUNO | a70.79 | 1549 | 1026 | 886.2 | 1138 | 638.7 | 551.6 | 708 | 910.3 | 841 | 997.4 | 2488 | 2237 | 2740 |
| PUNO | a80 | 2133 | 1137 | 954.3 | 1290 | 707.6 | 593.9 | 802.8 | 1425 | 1330 | 1539 | 3426 | 3091 | 3762 |
| SAN MARTIN | a0.9 | 190 | 9 | 9 | 9 | 0 | 0 | 0 | 190 | 190 | 190 | 365.3 | 365.3 | 365.3 |
| SAN MARTIN | a10.19 | 69 | 3 | 3 | 3 | 0 | 0 | 0 | 69 | 69 | 69 | 132.4 | 132.4 | 132.4 |
| SAN MARTIN | a20.29 | 153 | 14 | 14 | 14 | 0 | 0 | 0 | 153 | 153 | 153 | 300.9 | 300.9 | 300.9 |
| SAN MARTIN | a30.39 | 208 | 113.9 | 39 | 178.1 | 60.71 | 2.193 | 94.91 | 147.3 | 113.1 | 205.8 | 390.1 | 251.1 | 564.1 |
| SAN MARTIN | a40.49 | 322 | 281.3 | 191.6 | 339.8 | 150 | 102.1 | 181.1 | 172 | 140.9 | 219.9 | 603.9 | 455.8 | 752.3 |
| SAN MARTIN | a50.59 | 522 | 489.7 | 367.3 | 572 | 261.1 | 195.8 | 304.9 | 260.9 | 217.1 | 326.2 | 979 | 774.5 | 1184 |
| SAN MARTIN | a60.69 | 743 | 750.4 | 606 | 850.6 | 400.1 | 323.1 | 453.5 | 342.9 | 289.5 | 419.9 | 1393 | 1149 | 1638 |
| SAN MARTIN | a70.79 | 795 | 696.9 | 538.3 | 812.1 | 371.6 | 287 | 432.9 | 423.4 | 362.1 | 508 | 1491 | 1217 | 1765 |
| SAN MARTIN | a80 | 1207 | 1176 | 1007 | 1302 | 626.8 | 536.9 | 694.2 | 580.2 | 512.8 | 670.1 | 2264 | 1969 | 2559 |
| TACNA | a0.9 | 39 | 0 | 0.7386 | 0.7386 | 0 | 0 | 0 | 39 | 39 | 39 | 49.2 | 49.94 | 49.94 |
| TACNA | a10.19 | 18 | 1 | 1 | 1 | 0 | 0 | 0 | 18 | 18 | 18 | 23.71 | 23.71 | 23.71 |
| TACNA | a20.29 | 49 | 4 | 4 | 4 | 0 | 0 | 0 | 49 | 49 | 49 | 65.81 | 65.81 | 65.81 |
| TACNA | a30.39 | 77 | 34.13 | 6 | 47.57 | 27.05 | 4.115 | 37.12 | 49.95 | 39.88 | 72.88 | 97.13 | 56.3 | 139.5 |
| TACNA | a40.49 | 131 | 70.85 | 42.38 | 86.4 | 56.16 | 33.01 | 67.91 | 74.84 | 63.09 | 97.99 | 165.2 | 122 | 210 |
| TACNA | a50.59 | 225 | 171.6 | 141 | 189.2 | 136 | 111.2 | 149.4 | 88.99 | 75.61 | 113.8 | 283.8 | 236.3 | 332.8 |
| TACNA | a60.69 | 375 | 289.2 | 248.4 | 315.2 | 229.3 | 196.3 | 249.2 | 145.7 | 125.8 | 178.7 | 473 | 407 | 540.5 |
| TACNA | a70.79 | 396 | 237.7 | 187.7 | 271.3 | 188.4 | 148.2 | 214.5 | 207.6 | 181.5 | 247.8 | 499.5 | 416.7 | 583.9 |
| TACNA | a80 | 444 | 149.6 | 83.5 | 196.6 | 118.6 | 65.61 | 155.3 | 325.4 | 288.7 | 378.4 | 560.1 | 447.7 | 673.9 |
| TUMBES | a0.9 | 58 | 0 | 0.8239 | 0.8239 | 0 | 0 | 0 | 58 | 58 | 58 | 68.21 | 69.04 | 69.04 |
| TUMBES | a10.19 | 20 | 2 | 2 | 2 | 0 | 0 | 0 | 20 | 20 | 20 | 25.52 | 25.52 | 25.52 |
| TUMBES | a20.29 | 46 | 1 | 1 | 1 | 0 | 0 | 0 | 46 | 46 | 46 | 55.1 | 55.1 | 55.1 |
| TUMBES | a30.39 | 80 | 45.37 | 12 | 61.22 | 38.58 | 10.47 | 51.35 | 41.42 | 28.65 | 69.53 | 94.09 | 45.69 | 143 |
| TUMBES | a40.49 | 116 | 86.85 | 59.7 | 100.5 | 73.85 | 50.06 | 84.76 | 42.15 | 31.24 | 65.94 | 136.4 | 96.44 | 178.1 |
| TUMBES | a50.59 | 232 | 204.1 | 175 | 220.7 | 173.6 | 148.1 | 187 | 58.45 | 45.01 | 83.93 | 272.9 | 227.9 | 319.5 |
| TUMBES | a60.69 | 365 | 319.2 | 285.6 | 340.6 | 271.4 | 242.2 | 288.9 | 93.58 | 76.07 | 122.8 | 429.3 | 375.1 | 485.1 |
| TUMBES | a70.79 | 354 | 241.2 | 180.9 | 279.2 | 205.1 | 153.2 | 236.7 | 148.9 | 117.3 | 200.8 | 416.3 | 318.9 | 515.4 |
| TUMBES | a80 | 505 | 260.5 | 176.1 | 319.9 | 221.5 | 149 | 271.3 | 283.5 | 233.7 | 356 | 593.9 | 451 | 738.5 |
| UCAYALI | a0.9 | 137 | 9 | 9 | 9 | -101.4 | -266.3 | -13.65 | 238.4 | 150.7 | 403.3 | 394.5 | 252.7 | 661.3 |
| UCAYALI | a10.19 | 57 | 7 | 7 | 7 | 0 | 0 | 0 | 57 | 57 | 57 | 99.19 | 99.19 | 99.19 |
| UCAYALI | a20.29 | 135 | 105.6 | 41.15 | 137 | 65.32 | 25.2 | 84.48 | 69.68 | 50.52 | 109.8 | 218.4 | 122.9 | 314.6 |
| UCAYALI | a30.39 | 170 | 115.3 | 20 | 162.9 | 71.27 | 15.03 | 100.5 | 98.73 | 69.53 | 155 | 275 | 132.5 | 413.5 |
| UCAYALI | a40.49 | 213 | 213.8 | 167.9 | 240.6 | 132.2 | 103.5 | 148.5 | 80.8 | 64.5 | 109.5 | 344.5 | 272.2 | 417.6 |
| UCAYALI | a50.59 | 422 | 447.3 | 396.3 | 480.4 | 276.6 | 244.8 | 296.8 | 145.4 | 125.2 | 177.2 | 682.6 | 598.8 | 767.1 |
| UCAYALI | a60.69 | 596 | 620.2 | 534.9 | 678.5 | 383.4 | 330.5 | 419.2 | 212.6 | 176.8 | 265.5 | 964 | 820.8 | 1108 |
| UCAYALI | a70.79 | 654 | 703.9 | 615.2 | 762.1 | 435.2 | 380.1 | 470.9 | 218.8 | 183.1 | 273.9 | 1058 | 911.3 | 1205 |
| UCAYALI | a80 | 649 | 618.5 | 516 | 688.4 | 382.4 | 318.8 | 425.4 | 266.6 | 223.6 | 330.2 | 1050 | 877.8 | 1222 |
| Total | - | 211634 | 173099 | 153669 | 187488 | 108943 | 96507 | 118261 | 102691 | 93373 | 115127 | 334043 | 300147 | 367743 |

### Proportion total excess deaths per region

Table 5: Proportion total excess deaths per region

|  |  |  |
| --- | --- | --- |
| Departamento | suma | prop |
| AMAZONAS | NA | NA |
| ANCASH | 4155 | 4.069 |
| APURIMAC | 259.5 | 0.2542 |
| AREQUIPA | 5616 | 5.5 |
| AYACUCHO | 890.5 | 0.8721 |
| CAJAMARCA | 5345 | 5.235 |
| CALLAO | 7144 | 6.996 |
| CUSCO | 2272 | 2.225 |
| HUANCAVELICA | 306.8 | 0.3004 |
| HUANUCO | NA | NA |
| ICA | 4252 | 4.165 |
| JUNIN | 3096 | 3.032 |
| LA LIBERTAD | 8091 | 7.924 |
| LAMBAYEQUE | 4964 | 4.862 |
| LIMA | 87781 | 85.97 |
| LORETO | 5962 | 5.839 |
| MADRE DE DIOS | NA | NA |
| MOQUEGUA | 1087 | 1.065 |
| PASCO | 657.9 | 0.6443 |
| PIURA | 15661 | 15.34 |
| PUNO | 4071 | 3.987 |
| SAN MARTIN | 3534 | 3.461 |
| TACNA | NA | NA |
| TUMBES | NA | NA |
| UCAYALI | 2841 | 2.782 |

## Appendix 2

### Estimations based on mortality baselines and differences - robustness check

The overall excess mortality estimates obtained from the baseline-approach model are NA% below the estimates obtained using the PAF model. The age distribution of mortality is highly consistent in both models. However, most differences between both estimates are concentrated in the oldest age groups. Differences between both approaches are mainly due to the inclusion of the upper confidence interval are in the final count.

Table 5: Estimations based on mortality baselines and differences

|  |  |  |  |
| --- | --- | --- | --- |
| Age.group | Epi-weeks | Positive-Excess | All-Excess |
| 0-9 | 0 | 72.85 | -519.6 |
| 10-19 | 19.01 | 174.3 | 108.5 |
| 20-29 | 49.87 | 207.7 | -135.3 |
| 30-39 | 1591 | 1719 | 1595 |
| 40-49 | 6792 | 6834 | 6803 |
| 50-59 | 14059 | 14130 | 14085 |
| 60-69 | 23561 | 23623 | 23611 |
| 70-79 | 22807 | 22912 | 22885 |
| 80+ | 21169 | 21357 | 21357 |
| Grand Total | 90048 | 91030 | 89790 |

Note: Epi-weeks (column 2) includes excess deaths during periods in which the observed mortality was above the upper uncertainty interval; Positive-Excess (column 3) includes excess in which the observed mortality was above the baseline; and All-Excess (column 4) includes both positive and negative excess deaths.

## Appendix 3

We also compare our estimations with other studies in Peru.55 computes a comparison of registered deaths in Peru for months April to June of 2020 and corresponding periods in 2017-19 estimating 36,322 excess deaths. It does not include non-registered deaths or take improvements in data registration into account. Applying our approach to this time period gives an estimate of 35,461 (CI 95% 32,425 - 37,803) excess registered deaths which climbs to 49,648 (CI 95% 48,037 - 51,034). A similar comparison between 1 January to 12 July 2020 and the corresponding periods in 2017-19 shows excess 46,863 deaths, compared to 50,534 (CI 95% 44,448 - 55,582), applying our approach to the same period.56 This second study includes 2,000 excess deaths before March 2020, which cannot be attributed to the COVID-19 pandemic. A study of Lima metropolitan region finds an excess of 20,093 non-violent deaths for the first 24 weeks of 2020.57 This is above to our own estimate based on registered deaths in Lima over the same period: 14,659 (CI 95% 13,579 – 15,609). Adding unregistered deaths increases to 20,149 (CI 95% 18,839 - 21,323).

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2. University of East Anglia, Norwich, UK [↑](#footnote-ref-22)
3. Pan American Health Organisation, Washington D.C, USA [↑](#footnote-ref-23)
4. London School of Hygiene and Tropical Medicine, London, UK [↑](#footnote-ref-24)
5. London School of Hygiene and Tropical Medicine, London, UK [↑](#footnote-ref-25)
6. Max Planck Institute for Demographic Research, Rostock, Germany [↑](#footnote-ref-26)