Gender disparities in death registration during the COVID-19 pandemic in a low-resource setting

Abstract

In many low-income countries, the completeness of mortality information collected by civil registration systems is poor, and often differs by gender. Using survey data collected among 477 randomly selected urban households followed by the Bandim Health Project Health and Demography Surveillance System in Guinea-Bissau, we examined (1) how many and which deaths were registered between 2020-23, a period of potentially high mortality; (2) whether gender was associated with death registration, and how this association manifested; and (3) gender differences in reasons for (non-)registration. In total, less than a quarter (24%) of the 610 reported deaths were registered with the civil authority. No infant death was registered. A large gender gap in registration was observed among those aged 15+ at death (45% male vs. 22% female). Results from a formal decomposition analysis showed that compositional factors, in particular educational differences among the deceased, explained 79% of the disparity. Post-mortem pecuniary transfers were the main reported reasons for registration, especially of male and more educated deceased household members. Independent of gender, low perceived benefits and unawareness of the registration process were the primary reasons for not registering deaths.

Introduction

Civil registration and vital statistics (CRVS) systems are the enabling platforms for the official recording, compilation and documentation of vital events—including births, deaths and their causes—in a country's population in near real-time (AbouZahr et al., 2015). For governments, CRVS systems are necessary to generate timely and accurate demographic and health statistics for planning, evaluation, and monitoring purposes (Mikkelsen et al., 2015; Setel et al., 2007), including progress towards 12 of the 17 sustainable development goals (SDGs) (Mills et al., 2017). Functioning systems of death registration are an essential prerequisite for responding to health crises and mitigating their effects, such as in the case of the COVID-19 pandemic (Aburto et al., 2022; Achilleos et al., 2022; Peretz et al., 2022). More broadly, they are essential for the development and implementation of health and social protection policies and interventions (AbouZahr et al., 2021). Death registration is also foundational for trustworthy identity and identification systems and is thereby closely connected to the ability of individuals and families to exercise rights, and access financial and/or social protection services they may be eligible for after the death of a relative (Haider et al., 2021). Given that women tend to outlive men, the legal, social, and economic protections provided by death registration appear especially important for women who survive their male family members.

However, in many low-income and lower-middle-income countries (LLMICs), CRVS systems are deficient (AbouZahr et al., 2015; Karlinsky, 2024). In these settings, only a portion of deaths is registered, often with delays, and the certification of the causes may be poor (United Nations Statistics Division, 2020; WHO, 2014). When not all deaths are captured in registries, CRVS statistics tend to reflect the mortality patterns of those with greater access to registration services, thus producing a biased picture of mortality and a misrepresentation of some population groups. Among the most basic factors, the gender of the deceased has been identified as a source of inequalities in death registration. Although data is limited, evidence suggests that female deaths are more likely to be underreported (Adair et al., 2021; Cobos Muñoz et al., 2020). For example, gender disparities in death registration have been documented to range from 3 to 30 percentage points (p.p.) in countries as diverse as Morocco (Silva, 2016), Nepal, Bangladesh (Haider et al., 2021), and Ecuador (Peralta et al., 2019). Where levels of registration completeness is low (<80%) such gender bias in registration is often more pronounced (Adair et al., 2021).

Gender disparities in who gets registered are likely related to factors known to operate as incentives or barriers to the civil registration of deaths in LLMICs. For example, death registration typically provides relatives with the evidence needed to access inheritance, and social safety benefits and/or exercise land rights. Since in LLMICs, men are more likely to own properties, land, or work in the formal sector, such economic incentives may motivate households to register male and female deaths at different rates (Haider et al., 2021; Suthar et al., 2019). Given known gender disparities in mortality, women may become single-headed households after their partner's death and there may be no one available to register their own deaths (Kamiya & Hertog, 2020). Lack of knowledge of the CRVS process and its benefits may represent a major barrier to the civil registration of deaths (Fisker et al., 2019), and may especially affect the registration of female deaths in low-educated households as a result of a combination of higher unawareness, greater relative costs and lower perceived benefits. In addition, gender disparities in death registration may be related to differences in causes and places of death. For example, men's greater probability of dying of causes involving police investigations (e.g., injuries, accidents and assaults) (Waldron et al., 2005) and, in some countries, of dying in health facilities, can contribute to disparities in death certification and registration. Paradoxically, these issues are likely exacerbated during health crises, when timely monitoring of mortality trends is most needed.

In this study, we investigated the completeness of death registration with a focus on gender disparities and explored reasons for (non-)registration between 2020-23—a period of potentially high mortality related to the COVID-19 pandemic—in Guinea-Bissau, a low-income country in West Africa. We conducted a sample survey of 477 randomly selected households among those followed by the Bandim Health Project (BHP) Health Demographic Surveillance System (HDSS) in the country's capital. We recorded 610 deaths over the study period, of which less than a quarter were registered with the civil authority. Among adult deaths (ages 15+), we found a 23 p.p. gender gap in registration (45% male vs. 22% female). Results from a Fairlie decomposition analysis showed that compositional factors, educational differences among male and female adult deaths in particular, contributed to 79% of the observed disparity. We further documented gender-related differences in reasons for death registration, with male adult deaths being more likely to be registered for motivations related to post-mortem financial transfers (e.g., to claim pension, insurance, and inheritance). Independent of gender, we found that low perceived benefits and unawareness of the registration process were the primary reasons for non-registration, especially for children (aged 0-14).

This study contributes to a greater understanding of the correlates and drivers of (low) completeness of death registration in low-resource settings in times of health crises. This is important because CRVS systems remain the gold standard for population-related data and mortality measurement, and knowledge about the determinants and barriers to death registration can inform policy intended to scale up CRVS coverage as well as progress towards the monitoring of SDGs in LLMICs. Moreover, this study provides an angle to the literature on gender inequalities in health and socioeconomic conditions, which has so far paid limited attention to foundational issues related to death registration. The findings not only document a large under-recording of female deaths but also highlight how overall low coverage of death registration can be particularly onerous and a source of vulnerability for surviving women who, without death certificates for deceased family members, may not be able to assert their rights (Buvinic & Carey, 2019).

Study setting

Guinea-Bissau is a low-income country in West Africa (Figure 1). It has a population of about 2 million, a median age of 18 years and an estimated life expectancy at birth of 60 years (World Bank, 2023). The Ministry of Justice is responsible for managing the CRVS system (Guinea-Bissau Ministry of Justice, 2022; Mitala, 2021). As per Bissau-Guinean law, death registration is compulsory and free, but it has to be attained within 24 hours of the death and requires a medical death certificate reporting cause(s) of death and the identity card (*bilhete de identidade*) of the deceased (Mitala, 2021). Late registration is possible, but it is subject to a fee of about USD8 plus court costs. Death registration is mandatory for pension, insurance, and inheritance claims, among other financial transfers, and is also necessary to secure burial permits (UNICEF, 2024).

In 2020, death registration was possible at a total of 74 civil registration offices across the country (urban areas: 10; rural areas: 64) (Mitala, 2021). However, the Bissau-Guinean CRVS system faces significant constraints including human-resource bottlenecks and further organisational, operational, and legal challenges (Guinea-Bissau Ministry of Justice, 2022). The average distance between household residencies and registration offices is typically greater than 10km, and the general absence of public transportation, poor road conditions (Guinea-Bissau rural transport project, 2019) and widespread poverty, especially in rural areas (UNDP & OPHI, 2022), make it difficult to access CRVS sites in line with mandated deadlines for registration (Mitala, 2021). Recently, some reforms aiming at improving the CRVS organisational and regulatory structures, and modernising its to-date manually operated system have been initiated (Mitala, 2021). However, because of the issues detailed above, legislative requirements and regulations pertaining to the registration of vital events continue to be loosely enforced in practice (Fisker et al., 2019).

As in other African countries, the CVRS system in Guinea-Bissau is considered to be deficient and incomplete (Fisker et al., 2019; Guinea-Bissau Ministry of Justice, 2022) and therefore unsuited to produce reliable mortality estimates, particularly in periods of health crises. The COVID-19 pandemic, whose first case was detected in Guinea-Bissau on 25 March 2020, likely further worsened an already weak death registration system. Factors such as transportation constraints, curfews, social distancing, fears of infection, and financial hardships possibly amplified systemic gender disparities in the completeness of death registration.

Data

Data for this study come from a larger randomized trial on modes of mortality data collection and mortality trends and patterns during the COVID-19 pandemic in Guinea-Bissau (for details about the study design, see: Torrisi et al. (2024)). The main aim of the larger trial was to compare survey data of reports of dates of death elicited by either standard close-ended questions or event calendar approaches to records of deaths collected in the BHP-HDSS. Evaluating levels and correlates of death registration among elicited deaths was a secondary goal of the trial.

The BHP-HDSS has been operating since 1978, and its urban site follows over 100,000 individuals residing in five neighbourhoods situated in the capital city of Bissau (about 2km from the city centre) (Bjerregaard-Andersen et al., 2018; Fisker et al., 2016; Rodrigues et al., 2008). BHP-HDSS fieldworkers visit local households periodically to record demographic events such as pregnancies, births and deaths, thus implementing longitudinal surveillance of individuals from their time of registration. The BHP also frequently conducts trials of health interventions during which prospective mortality data is collected at shorter intervals among subsets of the population.

For the larger trial, a stratified random sample of households was drawn based on the lists of HDSS-registered households residing in neighbourhoods of the capital Bissau. Specifically, we oversampled households who had experienced at least one death between January 2020 and May 2022 according to HDSS records to ensure that sufficient numbers of reported deaths could be compared in the larger trial. The sample was stratified by neighbourhood of residence and time elapsed since the most recent household death was recorded by the HDSS.

Sampled households were visited in person by trained enumerators between April and July 2023. In each household, a regular member aged 18+ years old who spoke Guinea-Bissau Creole (the local vernacular language) was invited to serve as informant. Households where no eligible informant was available at the time of visit, or where the informant asked to reschedule the interview, were re-visited at a later date. We also revisited households (i) where deaths were expected based on HDSS records but were not reported during the first visit, and (ii) in which informants failed to provide information on death registration of any deceased during the first interview. Each selected household was visited up to 3 times. These revisits happened after a few weeks from the first interview and were conducted by a different fieldworker. In total, we recruited 477 households reporting at least one death among regular members since January 2020.

Informants were asked to complete questionnaires adapted from household questionnaires used in national censuses and nationwide household surveys (e.g., the Demographic and Health Surveys). All data were collected on tablets using SurveyCTO, a common data collection platform in LLMICs. Informants were asked to report any death among regular household members since January 2020 and provide socio-demographic details about each of them, including gender, age at death, schooling level and date of death. They were also asked to report the circumstances of each death, and specifically whether it was due to an accident, related to pregnancy, and occurred in a health facility. For each death, household informants were next asked to report the death registration status and reasons for (non-)registration. Enumerators were provided with a list of pre-specified reasons on their tablet, which was adapted from a prior study conducted in the same setting (Fisker et al., 2019). This list was not disclosed to respondents, but enumerators could record multiple responses. After each reason stated by respondents, interviewers were instructed to probe non-specifically by asking: "*Was there another reason why the death was (not) registered?*". Non-pre-specified reasons were recorded as free text (Appendix A, Table A1 for detailed questionnaire sections).

Methods

The analysis comprised three steps. We began by describing the characteristics of household informants and deaths reported to have occurred between January 2020–July 2023. We used χ^2 to test for gender differences in the characteristics of the reported deaths and in registration status. Next, we employed logistic regressions to assess crude differences in death registration by gender and whether relationships persisted with stepwise model expansion on covariates for the timing of death (in century month code (CMC)), individual and household socio-demographic characteristics.

Second, we performed a formal decomposition analysis to evaluate the extent to which compositional variables (e.g., age, education of the deceased) explained any observed statistical association between gender and death registration status among adult deaths (ages 15+). For this purpose, we employed a Fairlie decomposition analysis (FDA) (Fairlie, 1999, 2017; Jann, 2023), an extension of the Oaxaca–Blinder–Kitagawa decomposition method for non-linear regression models. In short, the FDA partitions inter-group (here, male vs. female) differences in the mean level of an outcome (here, death registration) into those due to differences in the distribution of observable characteristics ("explained component" or "endowment effects") across the two groups and those due to differences in unobserved characteristics of the two groups ("unexplained component" or "coefficient effects"). Details about the FDA are provided in Appendix B. We included dummies for place of death and accidental deaths in the regression equation, as well as age at death, education of the deceased and household wealth as individual variable grouped dummy variables. To meaningfully decompose differences in registration (especially by education), we restricted the sample for the FDA to deaths that occurred to individuals aged 15+. Moreover, since the number of male and female deaths differ, as recommended by Fairlie (2006), we used the parameter estimates from the pooled sample, controlling for differences in the timing of death by including time dummies. Finally, we specified random ordering of the variables and conducted 1,000 replications of the FDA procedure to ensure the stability of the results and address any issue of path dependence (the sensitivity of the decomposition results to the order in which explanatory variables are introduced in the model). We adjusted standard errors for the clustering of deaths within households.

Third, after assessing the presence and contributors to gender disparities in death registration, we investigated in detail the reasons for (not-)registering deaths. We examined distributions in the total sample of deaths and, using χ^2 tests, tested for differences by gender of the deceased and other relevant characteristics.

Results

Descriptive statistics

In total, 610 deaths were reported as having occurred between January 2020 and July 2023 by 477 households. Table 1 presents descriptive characteristics of household informants. Of these deaths, 42 were reported during follow-up visits conducted after checks with the HDSS data revealed that some households had not reported any household deaths during the first visit. Additionally, 74 households were revisited specifically to obtain information about death registration that was not provided during the first visit.

Table 2 provides information on the characteristics of the reported deaths, by gender. The majority (52%) of deaths concerned males. Infant deaths (<1 y) constituted 12% of all deaths, whereas 39% were of adults reportedly aged 60+ at the time of death. Information on age at death was not available for 1% of the deaths. 10% of the deceased had acquired higher education, whereas 37% concerned household members with either primary or secondary schooling. Information about schooling was unavailable (i.e., missing) or unknown for almost one-third, and was more likely to be unknown for male than female deaths (p=0.002).[1] A larger proportion of deaths occurred among females with no education. 58% of the deaths happened in a health facility and 4% were reported as due to an accident, with no differences by gender. Among women, 2 deaths (1.4%) were related to pregnancy complications.

Death registration

Of all deaths, 64% were not registered (Table 2). For 10%, civil registration status was unavailable (i.e., missing) or unknown to the informant. Deaths with unavailable information on registration status were not systematically different in terms of their socio-demographic characteristics from those with known registration status (Table C1). Among household informants' characteristics, only age was related to the availability of status information (p=0.020).

A considerable gender gap in registration appeared among deaths with available information on registration status (n=546): completed registration or registration in progress was reported for 37% of male deaths vs. 19% of female deaths (Figure 2, Panel A). The same pattern was observed for adult deaths (ages 15+) (Panel B), although the overall proportions of registered deaths were higher. This reflects the differences in age-sex-specific death registration rates: registration was highest in the 60-79-year-old age group and was higher at all adult ages (15+) for men compared with women. By contrast, registration was very rare for children and teenagers, with no infant death reported as registered (Figure 2, Panel C).

The gender gap in registration persisted in logistic regression models progressively adjusting for the timing of the deaths (Table C2, Model 2), socio-demographic and household characteristics (Model 3). Specifically, female deaths had 42% (95% CI: 0.35-0.95) lower odds of being registered compared with their male counterparts in fully adjusted models. Education of the deceased was positively related to registration (Model 3), with the relationship resulting largely from a difference among male deaths (Model 4). The odds of deaths being registered increased with household wealth but was unrelated to the informant's educational level (not shown). Registration was more likely for facility-based deaths, particularly among male deaths. Part of the observed gender gap in registration may therefore be explained by the differential composition of deaths between males and females.

Results of the formal decomposition analysis using the FDA method examining this hypothesis are reported in Table 3. Overall, jointly, endowment factors explained 79% of the observed gender disparities in death

[1] Note that we did not ask about education for deaths of children aged <4 y at the time of death, and for respondents with unknown age at death. Hence, the reported p-value pertains to a test for gender differences in the proportions of "Don't Know" (DK) responses to questions regarding the educational level of the deceased that was conducted on the sample of deaths for which education information was sought (n=527).

registration (controlling for time of death). The difference in educational composition of male and female deaths accounted for the largest explained portion of the gap (54%, Figure 3), followed by household wealth (12%). Age at death contributed partially (10%) to widening the gender gap in registration, whereas place of death and causes of death related to accidents appeared to play a low to negligible role.[2]

Reasons for (not) registering deaths

For the quarter of deaths that were registered or for whom registration was in progress (n=156), post-mortem financial transfers (i.e., insurance, government benefits, pensions and social services) were the most reported reasons for pursuing registration, followed by compliance with the law (Figure 4). No specific reasons (i.e., "don't know" answers) comprised 5% of all responses. Drivers of death registration differed by socio-demographic characteristics of the deceased. In specific, reasons related to post-mortem financial transfers were reported more frequently for male than female deaths (p<0.001). There were also differences in the proportion of responses stating post-mortem financial transfers as a reason for death registration by the deceased's level of education, and specifically between deaths of household members with secondary or higher education and those with primary or no schooling (p=0.010). Motives related to justifications for work leave were more frequently stated for female than male deaths (p=0.010), although note that this option was selected only 17 times overall. No other reason differed by gender or other socio-demographic characteristic of the deceased.

The perception that death registration provided no benefits was by far the most reported reason for not registering deaths, followed by general unawareness of the registration process and cost-related motives (Figure 5). No specific reasons (i.e., "don't know" answers) comprised 11% of all responses. Reported reasons for non-registration were independent of the gender of the deceased. However, unawareness of the registration process was more frequently stated for child deaths than for adult deaths (p<0.001). Respondents were more likely to cite high costs as a reason for not-registering deaths occurred to household members with less than secondary schooling compared with those with secondary or higher levels of education (p=0.005).

The option "COVID-19" constituted 3% of all autonomously reported reasons for not-registering deaths, with no differences by gender or age of the deceased. While COVID-19 was never stated as a reason for not-registering deaths that reportedly occurred in 2022-23, it was spontaneously indicated as a motivation for non-registration for 7% (11/153) of 2020 deaths. Only for 5 deaths, informants reported that COVID-19 disruptions led to the non-registration of deaths when directly asked in a follow-up question.

[2] These results were estimated using the `fairlie` Stata package (Jann, 2023). We further tested the results using the `mvdcmp` command in Stata (Powers et al., 2011) along with its new function `mvdcmpgroup` for grouping individual covariates for detailed decomposition as in Zajacova et al. (2021). This package produces multivariate decomposition analysis for nonlinear outcomes in the same fashion as the `fairlie` command, but it further provides the detailed decomposition and standard errors for the coefficient component (i.e., the "unexplained" part) (Powers et al., 2011). Since results were qualitatively similar, we prefer to use the `fairlie` command as it allows to add time of death as additional control variables to the pooled model.

Discussion and conclusion

In many LLMICs, the completeness and quality of mortality information collected in civil registration systems are poor, and often characterised by variation across population groups (AbouZahr et al., 2019; Silva, 2016). Using unique data collected from a sample of households followed by the BHP-HDSS in the capital city of Guinea-Bissau, we found that only about a quarter of deaths was registered during a time of potentially high mortality. This low level further subsumed large disparities by gender—specifically, a 23 p.p. gender gap in registration among adult (15y+) deaths. This result is in line with prior studies documenting systematic undercounts of female deaths in LLMICs (Haider et al., 2021; Peralta et al., 2019; Silva, 2016). Importantly, this finding echoes existing evidence that low overall levels of death registration completeness operate as an amplifier of male-female differentials in death registration (Adair et al., 2021), and thus suggests that programs aimed at expanding the overall coverage of death registration could be most effective in reducing the gender gap (Knowles, 2016).

Our results also indicate that differences in educational composition between adult male and female deceased and, to a lesser extent, household wealth and age at death, contributed the most to explaining gender disparities in death registration. Relatedly, among the subgroup of registered deaths, post-mortem financial transfers (e.g., to claim pension, insurance, inheritance) were the primary reasons reported by informants for registration, especially for male and deceased household members with secondary or higher education. High cost was instead more frequently reported as a motivation for not registering the deaths of household members with less than secondary schooling, a group where women are over-represented.

Altogether, these results serve to better understand the emergence and contributors to gender inequalities in death registration. Against the background of a generally limited access to education and low levels of schooling (UNICEF, 2021), women in Guinea-Bissau fare significantly worse than men with respect to educational participation. For example, the Gender Parity Index for preschool until the end of the first phase of primary schooling (grade 4) is over 90% (i.e., girls are slightly disadvantaged). However, for each additional education level it then declines consistently so that by the end of secondary school (grade 12), the ratio falls to 66% (i.e., 1.5 boys for each girl) (Marshall et al., 2020). Therefore, one of the potential explanations for our results is that, by getting more education, men are more likely to be employed, including in the limited available jobs that in Guinea-Bissau offer some kind of social protection (e.g., civil service jobs), possess an insurance and own properties (Embaló, 2021), which in turn incentivises families to register male deaths at a higher rate. An extension of this explanation could be related to greater access to key information sources about death registration in households experiencing the death(s) of more educated men. These households may also have greater economic resources to afford the direct and indirect costs of registering deaths, as well as the social status and connections that could speed up and/or reduce the costs associated with the registration process. It is also possible that low-educated deceased women were in the first place more likely to lack birth certificates and therefore be "invisible" to the CRVS system, which both constrained their educational opportunities (Corbacho et al., 2012) and limited the perceived "need"/"usefulness" of registering their death.

Besides documenting large gender inequalities in death registration and contributing factors, our results provided broader insights into perceived barriers to death registration in a low-resource context, and over a time period that was partially characterised by a combination of mobility restrictions and operational challenges related to the COVID-19 pandemic. In our sample, COVID-19 disruptions were reported as a motivation for non-registration for very few deaths that took place in 2020. A possible explanation for this low reporting frequency relates to changing practices and perceptions regarding the necessity of registration during a period of strict curfews and mobility restrictions. For example, COVID may have influenced burial practices (recall that in Guinea-Bissau death registration is legally required to obtain burial permits), leading households to opt for "at-home" burials rather than cemetery burials. A shift of this kind may have then resulted in informants only reporting the lack of benefits as a reason for non-registration. At the same time, however, when we asked directly in a follow-up question, household informants reported that COVID-19 represented an obstacle to death registration for only a handful of cases with known registration status. Alternatively, it is possible that, where more systemic factors are at play, such as limited knowledge of the benefits of death registration and unawareness of the process itself, crisis events like the pandemic become only an additional impediment to the registration of deaths.

The presence of such knowledge-related barriers, as well as the remarkably low levels of registration of infant deaths, were similarly observed in a prior study in the same setting that focused exclusively on death registration of children aged below 2 years (Fisker et al., 2019). Information and awareness campaigns about death registration and its benefits could thus be leveraged to enhance death registration coverage in Guinea-Bissau. Public awareness campaigns underscoring the value of registering deaths should specifically target women given that they already face considerable social disadvantage and do not enjoy the same opportunities and rights as their male counterparts (Embaló, 2021), and the lack of death certificates for deceased family members may further entrench such inequalities.

While this study is among the few quantifying gender disparities in death registration and their contributing factors in LLMICs, there are multiple limitations to acknowledge. First, we did not ask household informants to show certificates of death registration after they reported that a death had been registered. Recall bias may be present due to the time elapsed since the death of a household member and/or any changes in household composition (i.e., who among regular members remained at the residence) following a death. Therefore, our results possibly overestimate the real extent of coverage of death registration. Relatedly, without information on dates of registration—which are typically available on death certificates—we could only investigate registration uptake, but not its timeliness. Second, our sample of deaths was not large enough to investigate several aspects of death registration across population groups. For example, the extremely low levels of registration among children aged 0-14 precluded any sensible analysis of factors that may act as incentives to the registration of such deaths. It is also important to note that our study was only conducted in an urban area covered by the BHP-HDSS, where access to CRVS offices and knowledge about registration is likely highest. Enablers/barriers to death registration likely operate differently in the capital than in rural settings and/or parts of urban Bissau that are not covered by the HDSS. For example, higher poverty rates in rural areas and transportation costs to reach the nearest civil registry office may constitute a more important obstacle than in urban areas, even if registration is free of charge, and so may be penalties for late registration. Similarly, residents of the BHP-HDSS study area may have greater awareness of civil registration due to general contact with BHP fieldworkers than residents of neighbouring non-covered areas. Finally, all data used in this study are quantitative in nature. As such, they provide a descriptive snapshot of the main perceived barriers and enablers of death registration in Guinea-Bissau. Future research could complement our findings with qualitative data, e.g., through focus group discussions, that could delve into the specific mechanisms through which reported barriers/enablers operate and, perhaps, could identify additional ones that may not have been elicited in our survey.

References

AbouZahr, C., Bratschi, M. W., Cercone, E., Mangharam, A., Savigny, D. de, Dincu, I., Forsingdal, A. B., Joos, O., Kamal, M., Fat, D. M., Mathenge, G., Marinho, F., Mitra, R. G., Montgomery, J., Muhwava, W., Mwamba, R., Mwanza, J., Onaka, A., Sejersen, T. B., … Setel, P. (2021). The COVID-19 Pandemic: Effects on Civil Registration of Births and Deaths and on Availability and Utility of Vital Events Data. *American Journal of Public Health*, *111*(6), 1123–1131. https://doi.org/10.2105/AJPH.2021.306203

AbouZahr, C., de Savigny, D., Mikkelsen, L., Setel, P. W., Lozano, R., & Lopez, A. D. (2015). Towards universal civil registration and vital statistics systems: The time is now. *Lancet (London, England)*, *386*(10001), 1407–1418. https://doi.org/10.1016/S0140-6736(15)60170-2

Aburto, J. M., Schöley, J., Kashnitsky, I., Zhang, L., Rahal, C., Missov, T. I., Mills, M. C., Dowd, J. B., & Kashyap, R. (2022). Quantifying impacts of the COVID-19 pandemic through life-expectancy losses: A population-level study of 29 countries. *International Journal of Epidemiology*, *51*(1), 63–74. https://doi.org/10.1093/ije/dyab207

Achilleos, S., Quattrocchi, A., Gabel, J., Heraclides, A., Kolokotroni, O., Constantinou, C., Pagola Ugarte, M., Nicolaou, N., Rodriguez-Llanes, J. M., Bennett, C. M., Bogatyreva, E., Schernhammer, E., Zimmermann, C., Costa, A. J. L., Lobato, J. C. P., Fernandes, N. M., Semedo-Aguiar, A. P., Jaramillo Ramirez, G. I., Martin Garzon, O. D., … Demetriou, C. A. (2022). Excess all-cause mortality and COVID-19-related mortality: A temporal analysis in 22 countries, from January until August 2020. *International Journal of Epidemiology*, *51*(1), 35–53. https://doi.org/10.1093/ije/dyab123

Adair, T., Gamage, U. S. H., Mikkelsen, L., & Joshi, R. (2021). Are there sex differences in completeness of death registration and quality of cause of death statistics? Results from a global analysis. *BMJ Global Health*, *6*(10), e006660. https://doi.org/10.1136/bmjgh-2021-006660

Bjerregaard-Andersen, M., Lund, N., Joergensen, A. S. P., Jepsen, F. S., Unger, H. W., Mane, M., Rodrigues, A., Bergström, S., & Benn, C. S. (2018). Stillbirths in urban Guinea-Bissau: A hospital- and community-based study. *PLOS ONE*, *13*(5), e0197680. https://doi.org/10.1371/journal.pone.0197680

Buvinic, M., & Carey, E. (2019). *Leaving no one behind: CRVS, Gender and the SDGs* (Knowledge Brief Seires on Gender and CRVS). Centre of Excellence for Civil Registration and Vital Statistics Systems, International Development Research Centre. http://hdl.handle.net/10625/57452

Cobos Muñoz, D., Sant, C., & Revenga Becedas, R. (2020). *The Dangers of Gender Bias in CRVS and Cause of Death Data: The Path to Health Inequality.* (Knowledge Brief Series on Gender and CRVS.). Centre of Excellence for Civil Registration and Vital Statistics (CRVS) Systems, International Development Research Centre.

Corbacho, A., Brito, S., & Osorio Rivas, R. (2012). *Birth Registration and the Impact on Educational Attainment* (IDB Publications (Working Papers) 4060). Inter-American Development Bank. https://econpapers.repec.org/paper/idbbrikps/4060.htm

Embaló, B. (2021). *UNDP Guinea-Bissau Gender Analysis* (UNDP Guinea-Bissau Gender Analysis). UNDP. https://www.undp.org/guinea-bissau/publications/undp-guinea-bissau-gender-analysis

Fairlie, R. (1999). The Absence of the African‐American Owned Business: An Analysis of the Dynamics of Self‐Employment. *Journal of Labor Economics*, *17*(1), 80–108. https://doi.org/10.1086/209914

Fairlie, R. (2017). *Addressing Path Dependence and Incorporating Sample Weights in the Nonlinear Blinder-Oaxaca Decomposition Technique for Logit , Probit and Other Nonlinear Models.* https://www.semanticscholar.org/paper/Addressing-Path-Dependence-and-Incorporating-Sample-Fairlie/98994046cf1881cbfe893d32c8a71dd42d414502

Fisker, A. B., Biering-Sørensen, S., Lund, N., Djana, Q., Rodrigues, A., Martins, C. L., & Benn, C. S. (2016). Contrasting female-male mortality ratios after routine vaccinations with pentavalent vaccine versus measles and yellow fever vaccine. A cohort study from urban Guinea-Bissau. *Vaccine*, *34*(38), 4551–4557. https://doi.org/10.1016/j.vaccine.2016.07.034

Fisker, A. B., Rodrigues, A., & Helleringer, S. (2019). Differences in barriers to birth and death registration in Guinea-Bissau: Implications for monitoring national and global health objectives. *Tropical Medicine & International Health*, *24*(2), 166–174. https://doi.org/10.1111/tmi.13177

Guinea Bissau Ministry of Justice. (2022). *Registro civil horizonte 2028: Estratégia nacional de registro civil e produção de estatísticas vitais*. Ministério da Justiça, Governo da Guiné-Bissau.

Guinea-Bissau rural transport project. (2019). *Guinea-Bissau rural transport project: Impact evaluation on rural roads, transport costs, women's access and local welfare in Guinea-Bissau*. World Bank. https://pubdocs.worldbank.org/en/637241579711672712/Policy-Brief-Guinea-Bissau-Rural-Transport-Project.pdf

Haider, M. M., Alam, N., Ibn Bashar, M., & Helleringer, S. (2021). Adult death registration in Matlab, rural Bangladesh: Completeness, correlates, and obstacles. *Genus*, *77*(1), 13. https://doi.org/10.1186/s41118-021-00125-7

Jann, B. (2023). FAIRLIE: Stata module to generate nonlinear decomposition of binary outcome differentials. *Statistical Software Components*. https://ideas.repec.org//c/boc/bocode/s456727.html

Kamiya, Y., & Hertog, S. (2020). *Measuring household and living arrangements of older persons around the world: The United Nations Database on the Households and Living Arrangements of Older Persons 2019.* (Technical Paper 3). United Nations, Department of Economics and Social Affairs, Population Division. https://desapublications.un.org/working-papers/measuring-household-and-living-arrangements-older-persons-around-world-united

Karlinsky, A. (2024). International completeness of death registration. *Demographic Research*, *50*, 1151–1170.

Knowles, J. C. (2016). *Assessment of the Quality and Relevance of Existing Data to Monitor the Gender Dimensions of CRVS in Asia and the Pacific—Data2X*. UN Foundation under the Data2X Initiative.

Marshall, J. H., Nicolai, M., & Silva, R. da. (2020). Out-of-school children in Guinea-Bissau: A mixed-methods analysis. *International Journal of Educational Development*, *77*, 102223. https://doi.org/10.1016/j.ijedudev.2020.102223

Mikkelsen, L., Phillips, D. E., AbouZahr, C., Setel, P. W., de Savigny, D., Lozano, R., & Lopez, A. D. (2015). A global assessment of civil registration and vital statistics systems: Monitoring data quality and progress. *The Lancet*, *386*(10001), 1395–1406. https://doi.org/10.1016/S0140-6736(15)60171-4

Mills, S., AbouZahr, C., Kim, J., & Sarpong, D. (2017). *Civil registration and vital statistics (CRVS) for monitoring the Sustainable development goals (SDGS)*. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/979321495190619598/civil-registration-and-vital-statistics-crvs-for-monitoring-the-sustainable-development-goals-sdgs

Mitala, H. (2021). *Breve resumo o sistema de registo civil e estatísticas vitais de Republic of Guinea-Bissau* (Centro de Excelência para Sistemas de Registo Civil e Estatísticas Vitais). International Development Centre. http://hdl.handle.net/10625/60417

Peralta, A., Benach, J., Borrell, C., Espinel-Flores, V., Cash-Gibson, L., Queiroz, B. L., & Marí-Dell'Olmo, M. (2019). Evaluation of the mortality registry in Ecuador (2001–2013) – social and geographical inequalities in completeness and quality. *Population Health Metrics*, *17*(1), 3. https://doi.org/10.1186/s12963-019-0183-y

Peretz, C., Rotem, N., Keinan-Boker, L., Furshpan, A., Green, M., Bitan, M., & Steinberg, D. M. (2022). Excess mortality in Israel associated with COVID-19 in 2020–2021 by age group and with estimates based on daily mortality patterns in 2000–2019. *International Journal of Epidemiology*, *51*(3), 727–736. https://doi.org/10.1093/ije/dyac047

Powers, D. A., Yoshioka, H., & Yun, M.-S. (2011). Mvdcmp: Multivariate Decomposition for Nonlinear Response Models. *The Stata Journal*, *11*(4), 556–576. https://doi.org/10.1177/1536867X1201100404

Rodrigues, A., Schellenberg, J. A., Kofoed, P.-E., Aaby, P., & Greenwood, B. (2008). Changing pattern of malaria in Bissau, Guinea Bissau. *Tropical Medicine & International Health*, *13*(3), 410–417. https://doi.org/10.1111/j.1365-3156.2008.02016.x

Setel, P. W., Macfarlane, S. B., Szreter, S., Mikkelsen, L., Jha, P., Stout, S., & AbouZahr, C. (2007). A scandal of invisibility: Making everyone count by counting everyone. *The Lancet*, *370*(9598), 1569–1577. https://doi.org/10.1016/S0140-6736(07)61307-5

Silva, R. (2016). *Disentangling Sex-Differentials in Death Registration & Mortality Estimates: Preliminary Findings from Morocco & Kuwait. United Nations.* Expert Group Meeting on Methodology for and Lessons Learned from CRVS Assessments. un.org/en/development/ desa/population/events/pdf/expert/26/ presentations/Session3/silva-DDMsslides- 2016-11-03.pdf

Suthar, A. B., Khalifa, A., Yin, S., Wenz, K., Fat, D. M., Mills, S. L., Nichols, E., AbouZahr, C., & Mrkic, S. (2019). Evaluation of approaches to strengthen civil registration and vital statistics systems: A systematic review and synthesis of policies in 25 countries. *PLOS Medicine*, *16*(9), e1002929. https://doi.org/10.1371/journal.pmed.1002929

Torrisi, O., Fisker, A., Fernandes, D., & Helleringer, S. (2024). *Improving retrospective data on recent household deaths: A randomized trial in Guinea-Bissau.* Population Association of America Annual Conference, Columbus, OH.

UNDP & OPHI. (2022). 2022 Global Multidimensional Poverty Index (MPI): Unpacking deprivation bundles to reduce multidimensional poverty. In *Human Development Reports*. United Nations Development Programme (UNDP) and OPHI (Oxford Poverty and Human Development Initiative). https://hdr.undp.org/content/2022-global-multidimensional-poverty-index-mpi

UNICEF. (2021). *Access to Learning in Guinea-Bissau*. United Nations International Children's Emergency Fund. https://www.unicef.org/guineabissau/access-learning

UNICEF. (2024). *CRVS - Birth, Marriage and Death Registration in Guinea-Bissau*. UNICEF DATA. https://data.unicef.org/crvs/guinea-bissau/

United Nations Statistics Division. (2020). *Demographic and Social Statistics*. https://unstats.un.org/unsd/demographic-social/crvs/index.cshtml

Waldron, I., McCloskey, C., & Earle, I. (2005). Trends in gender differences in accidents mortality. *Demographic Research*, *13*, 415–454. https://doi.org/10.4054/DemRes.2005.13.17

WHO. (2014). *Global Civil Registration and Vital Statistics Scaling up Investment Plan 2015–2024*. World Health Organizaition. https://www.who.int/publications-detail-redirect/global-civil-registration-and-vital-statistics-scaling-up-investment-plan-2015-2024

World Bank. (2023, June 5). *World Bank Country Profile: Guinea-Bissau*. World Bank Open Data. https://data.worldbank.org/country/guinea-bissau?view=chart

Zajacova, A., Grol-Prokopczyk, H., & Zimmer, Z. (2021). Pain Trends Among American Adults, 2002–2018: Patterns, Disparities, and Correlates. *Demography*, *58*(2), 711–738. https://doi.org/10.1215/00703370-8977691

Tables

Table 1 Characteristics of household respondents to recent household deaths module

	Number	Percent
Informant's characteristics		
Age		
18-29	192	(40.3%)
30-49	197	(41.3%)
50-64	62	(13.0%)
65+	23	(4.8%)
Unknown, but 18+	3	(0.6%)
Sex		
Male	140	(29.4%)
Female	337	(70.6%)
Education level		
No schooling	45	(9.4%)
Primary (≤ 6 y)	81	(17.0%)
Secondary (7-12 y)	281	(58.9%)
Higher (>12 y)	70	(14.7%)
Civil status		
Single	256	(53.7%)
Officially/traditionally married/cohabiting	137	(28.7%)
Widowed	74	(15.5%)
Divorced/separated	10	(2.1%)
Household's characteristics		
Household size		
<4 members	37	(7.8%)
4-9	292	(61.2%)
10+	148	(31.0%)
Wealth quintile		
Lowest	98	(20.5%)
Second	106	(22.2%)
Middle	124	(26.0%)
Fourth	53	(11.1%)
Highest	96	(20.1%)
Obs.	477	

Notes: Household wealth calculated using a standardized index combining information on household ownership of nine selected items (fridge, pressure cooker, washing machine, electricity, television, computer/laptop, home Wi-Fi, motorcycle/scooter, car) through Principal Component Analysis (PCA) and similar to the one compiled by the Demographic and Health Survey Program (2023). The PCA procedure first standardises the indicator variables (by calculating z-scores); then computes the factor coefficient scores (factor loadings); finally, for each household, the indicator values are multiplied by the loadings and summed to produce final values on each PCA axis. Following the DHS convention, only the first of the factors is used to obtain the index.

Table 2 Characteristics of reported deaths, Guinea-Bissau 2020-23

	Male	Female	Total	p-value
Age at death				0.14
<1 y	42 (13.2%)	29 (10.0%)	71 (11.6%)	
1-14	9 (2.8%)	14 (4.8%)	23 (3.8%)	
15-59	137 (42.9%)	139 (47.8%)	276 (45.2%)	
60-79	105 (32.9%)	75 (25.8%)	180 (29.5%)	
80+	23 (7.2%)	31 (10.7%)	54 (8.9%)	
DK	3 (0.9%)	3 (1.0%)	6 (1.0%)	
Education of deceased				<0.001
No schooling	25 (7.8%)	100 (34.4%)	125 (20.5%)	
Primary (≤ 6 y)	60 (18.8%)	61 (21.0%)	121 (19.8%)	
Secondary (7-12 y)	64 (20.1%)	43 (14.8%)	107 (17.5%)	
Higher (>12 y)	52 (16.3%)	10 (3.4%)	62 (10.2%)	
DK	73 (22.9%)	39 (13.4%)	112 (18.4%)	
Missing	45 (14.1%)	38 (13.1%)	83 (13.6%)	
Place of death				0.79
Health facility	188 (58.9%)	166 (57.0%)	354 (58.0%)	
Outside health facility	129 (40.4%)	122 (41.9%)	251 (41.1%)	
Refused/DK	2 (0.6%)	2 (1.0%)	5 (0.8%)	
Accidental death				0.33
Yes	16 (5.0%)	9 (3.1%)	25 (4.1%)	
No	302 (94.7%)	281 (97.3%)	583 (95.6%)	
Refused/DK	1 (0.3%)	1 (0.3%)	2 (0.4%)	
Death related to pregnancy complications*				
Yes		2 (1.4%)	2 (1.4%)	
No		92 (66.2%)	92 (66.2%)	
Missing		45 (32.4%)	45 (32.4%)	
Death registration status				<0.001
Yes	100 (31.3%)	46 (15.8%)	146 (23.9%)	
In progress, but not finalised	7 (2.2%)	3 (1.0%)	10 (1.6%)	
No	179 (56.1%)	211 (72.5%)	390 (63.9%)	
DK	31 (9.7%)	27 (9.3%)	58 (9.5%)	
Missing	2 (0.6%)	4 (1.4%)	6 (1.0%)	
Obs.	319	291	610	

Notes: * Female deaths aged 15-59 only.

Table 3 Fairlie decomposition of gender gap in death registration among adult deaths (ages 15+)

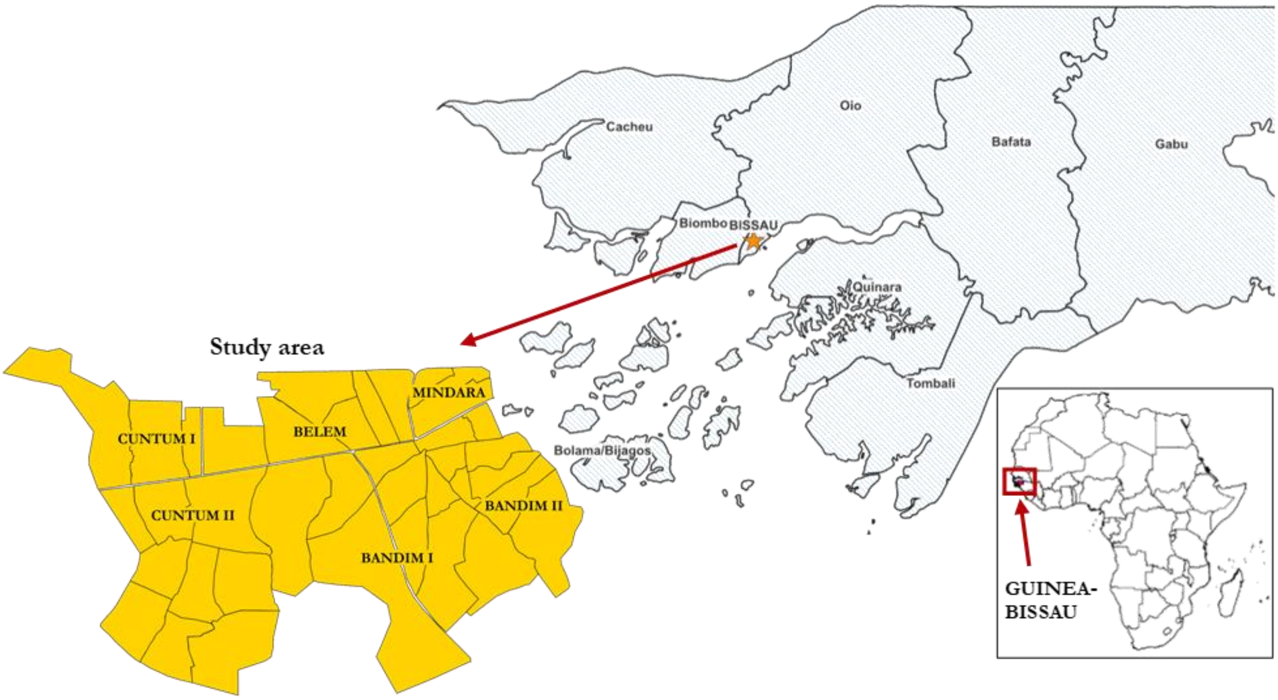
Terms of decomposition	Death registration
Mean prediction among male deaths	0.447
Mean prediction among female deaths	0.218
Gender difference	0.230
Explained (%)	0.183 (79.4%)
Non-explained (%)	0.047 (20.6%)

Explained contribution to difference	*p-value*	β	Contribution (%)	[95%*CI*]
Age at death	0.08	0.022	9.61%	(-0.002; 0.047)
Place of death	0.15	0.009	3.96%	(-0.003; 0.022)
Accidental death	0.75	0.001	0.43%	(-0.005; 0.007)
Education	<0.001	0.123	53.60%	(0.076; 0.170)
Household wealth	0.05	0.027	11.90%	(-0.001; 0.055)

Note: Gender disparities in death registration using dummies for place of death and whether the death was due to an accident in the regression equation. Age at death, education of the deceased and household wealth are included as individual variable grouped dummy variables. Parameter estimates from the pooled sample, controlling for time of death (CMC) dummies. Random ordering of the variables and 1,000 replications of the FDA procedure were used. Standard errors adjusted for clustering of deaths within households. Household wealth calculated using a standardized index combining information on household ownership of nine selected items (fridge, pressure cooker, washing machine, electricity, television, computer/laptop, home Wi-Fi, motorcycle/scooter, car) through Principal Component Analysis (PCA) and similar to the one compiled by the Demographic and Health Survey Program (2023). The PCA procedure first standardizes the indicator variables (by calculating z-scores); then computes the factor coefficient scores (factor loadings); finally, for each household, the indicator values are multiplied by the loadings and summed to produce final values on each PCA axis. Following the DHS convention, only the first of the factors is used to obtain the index. Note that the sample includes only deaths reportedly occurred at ages 15+.

Figures

Figure 1 Map of Guinea-Bissau and the study area



Source: DIVA-GIS (2023) for shapefiles.

Figure 2 Proportion of registered deaths by deceased's gender at all ages (Panel A), among aged 15+ (Panel B) and age-sex specific death registration rates (Panel C) among deaths with valid information on registration status

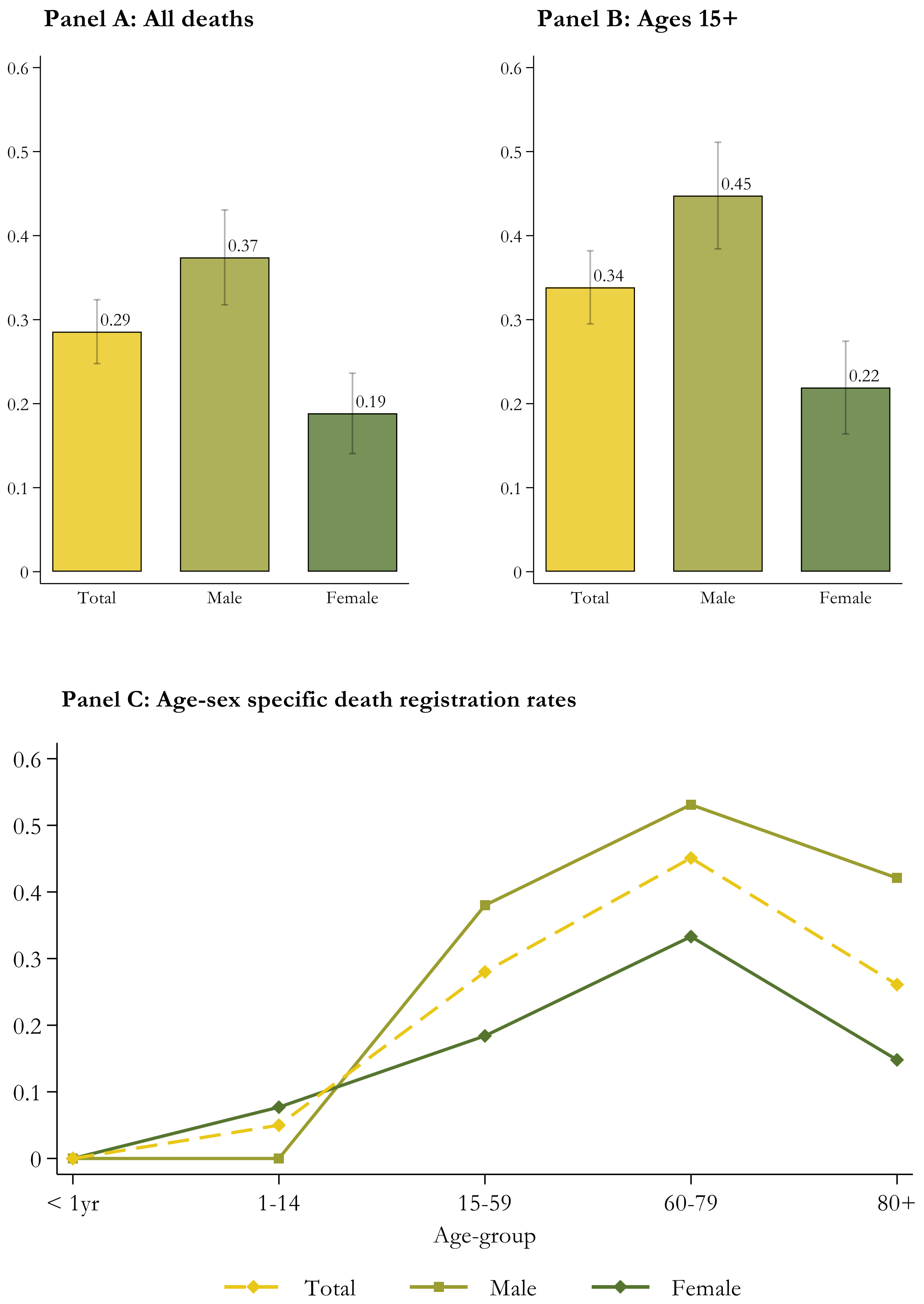
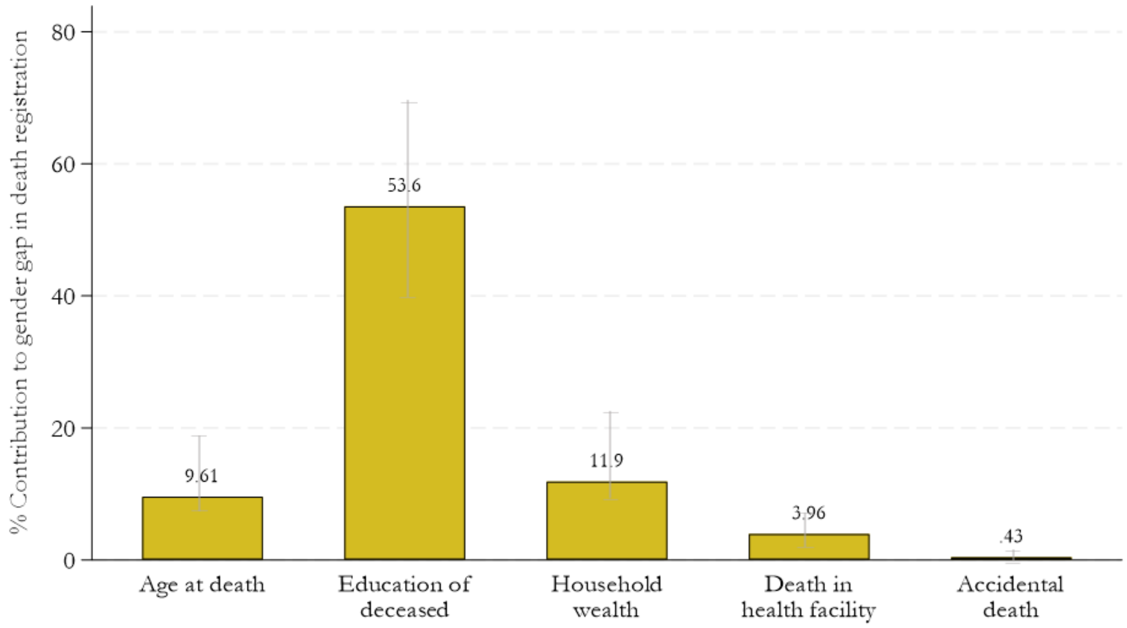
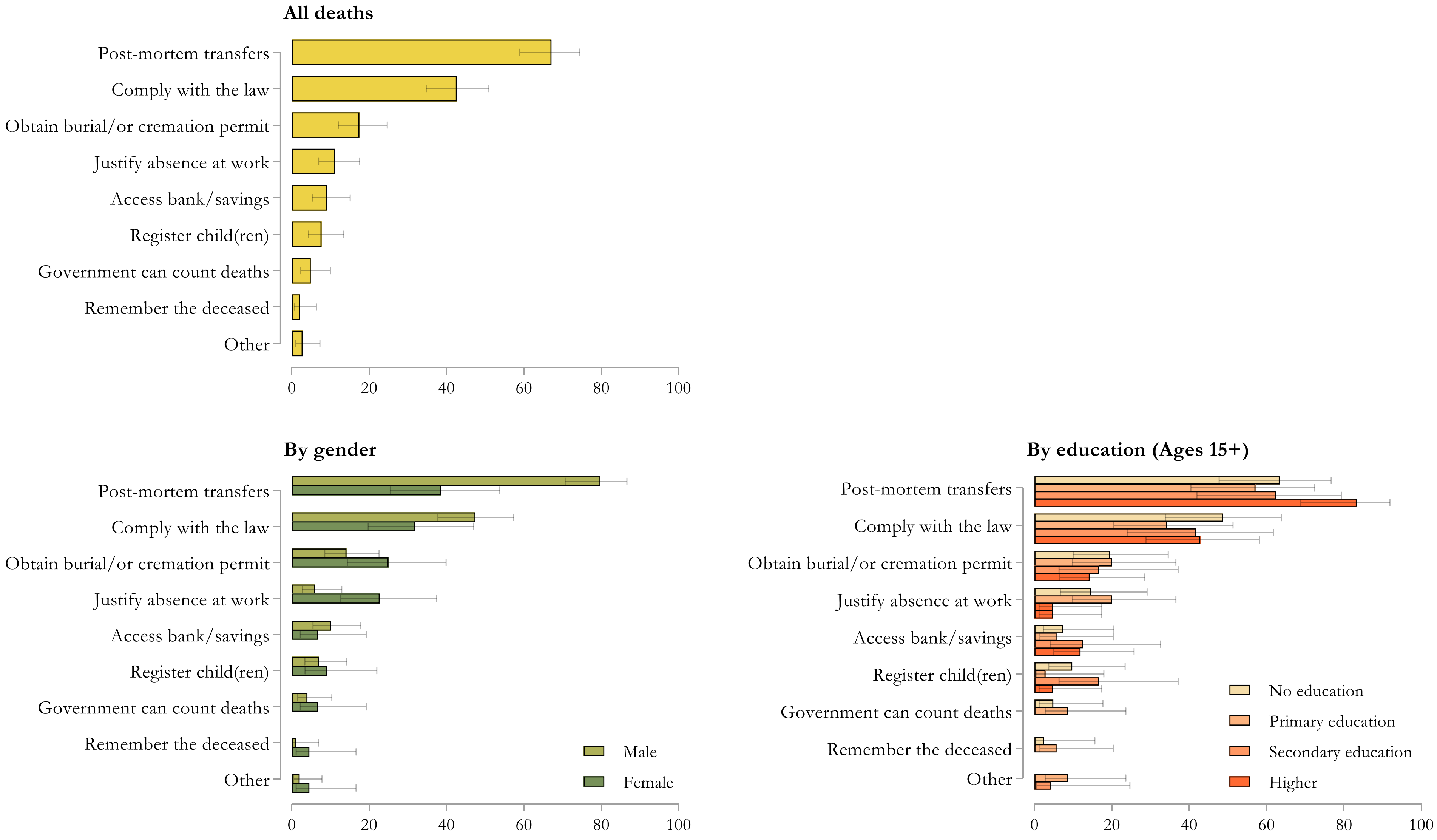


Figure 3 Fairlie decomposition of gender gap in death registration among adult deaths (ages 15+)



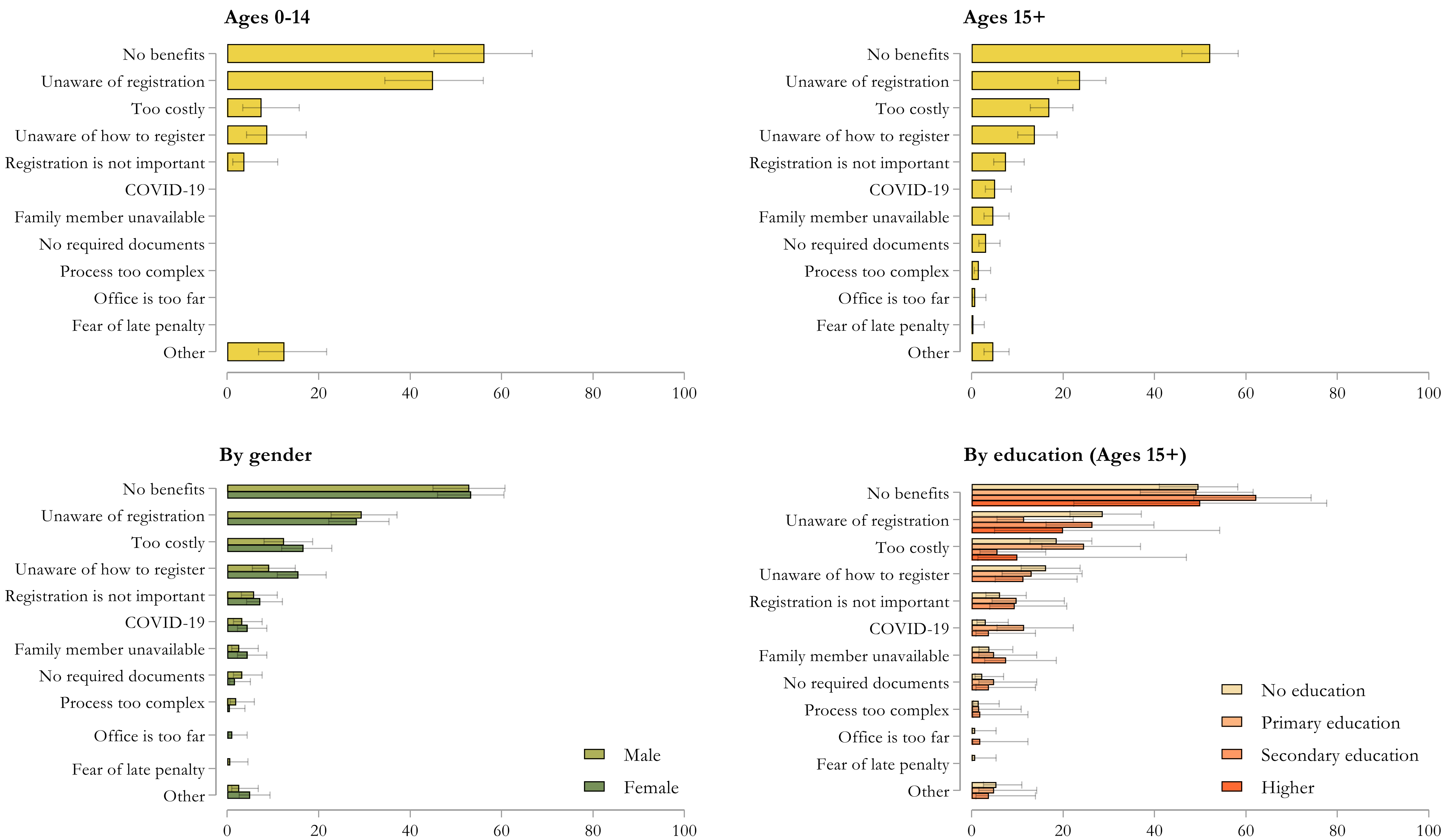
Note: Results from the Fairlie decomposition method, showing the contribution (%) of each covariate to gender gap in death registration. Table 2 for tabular results. A positive contribution indicates that particular variable is widening the gender gap in death registration. Note that the sample includes only deaths reportedly occurred at ages 15+.

Figure 4 Reported reasons for registering deaths (n=156)



Note: We do not show age-disaggregated figures due to the low number of reportedly registered deaths at ages (0-14).

Figure 5 Reported reasons for not registering deaths (n=448)



Note: The category "other" comprises non-pre-specified reasons such as the facts that the person died at home, died far from the household neighbourhood (e.g., "Died outside the Bissau (city)", "Died at sea"), the emotional distress related to the death ("The household was grieving, so we did not think about registration") or the recency of the death ("Did not register because the death is recent").

Appendix A

Table A1. Questionnaire sections

Household informant background questions
Gender, age, schooling, civil status

Household characteristics
Household size, household ownership of specified items (fridge, pressure cooker, washing machine, electricity, television, computer/laptop, home Wi-Fi, motorcycle/scooter, car)

Household deaths
Number of deaths occurred in household since January 2020
Gender, age at death, month and year of death, schooling level of the deceased, place of death, circumstances of death (accident, pregnancy complications)

Registration status of household deaths
Death was registered with the civil authority

Reasons for registering the death (multiple choice)
Avail insurance
Receive government benefits
Obtain pension
Access social services
For inheritance purposes
Comply with the law
Government can count deaths
Obtain burial/cremation permit
Remember the deceased
Other (specify) [free text]
DK
Refused
* Probe: *Any other reason why the death was register*

Reasons for not registering the death (multiple choice)
Unaware of death registration
Unaware of how to register a death
Process of death registration is too costly
Place of registration is too far
Registration process is too complicated
Don't have the required documents (e.g., id card)
Not important to register the death
Worried about having to pay a fine (late penalty)
No benefit of registering
Because of COVID-19
- If YES: How COVID-19 affected the decision to not register the death

Other (specify) [free text]
DK
Refused
* Probe: *Any other reason why the death was not register*

COVID-19 impacts
COVID-19 affected in any way registration (asked only for deaths with available registration status)

Appendix B

The FDA can be used to quantify the contribution of different socio-economic and demographic predictors explaining the gap in a given binary outcome (in our case, death registration) between groups (in our case, a binary gender categorisation). This method decomposes inter-group difference in the average level of an outcome into those due to different observable characteristics ("explained" or endowment" effect) across groups and those due to differences in non-measurable or unobserved characteristics of groups ("unexplained" or "coefficient" effects).

The decomposition for a non-linear equation $y = F(x\beta)$ takes the following form (Fairlie, 1999):

$$\bar{Y}^A - \bar{Y}^B = \left[\sum_{i=1}^{N^A} \frac{F(X_i{}^A\hat{\beta}^A)}{N^A} - \sum_{i=1}^{N^B} \frac{F(X_i{}^B\hat{\beta}^A)}{N^B}\right] + \left[\sum_{i=1}^{N^B} \frac{F(X_i{}^B\hat{\beta}^A)}{N^B} - \sum_{i=1}^{N^B} \frac{F(X_i{}^B\hat{\beta}^B)}{N^B}\right]$$

Where $\bar{Y}^A$ and $\bar{Y}^B$ are the mean probabilities of the binary outcome (death registration) in the two groups (male and female deaths). $\hat{\beta}^A$ and $\hat{\beta}^B$are the estimated coefficient vectors, and F is the cumulative distribution function of the logistic distribution. N^A and N^B denote the sample sizes of each group (male and female deaths). The first term in brackets in the Equation above represents the part of the observed gap in death registration between male and female deaths due to endowments (i.e., any disparity in death registration attributable to the differential distribution of explanatory variables between male and female deaths). In essence, this means that a registration gap could be closed if female deaths have the same characteristics as male deaths. The second term in Eq. (1) instead indicates the part in death registration gaps due to differences in the levels of Y. This latter also captures the part of gender differences in the outcome that is due to group to unobserved/coefficient effects.

Given that the different number of male and female deaths, we use the parameter estimates from the pooled sample to find the probabilities, as recommended by Fairlie (2006), controlling for time of death (in century-month) fixed effects. We address the issue of path dependence (the sensitivity of the decomposition results to the order of in which explanatory variables are introduced in the FDA) by randomly ordering the variables across replications 1,000 replications.

Appendix C

Table C1 Differences between deaths with/without valid information on registration status

	Status available	Status unavailable	Total	p-value
Age at death				0.26
<1 yr	67 (12.3%)	4 (6.2%)	71 (11.6%)	
1-14	21 (3.8%)	2 (3.1%)	23 (3.8%)	
15-59	246 (45.1%)	30 (46.9%)	276 (45.2%)	
60-79	163 (29.9%)	18 (28.1%)	181 (29.7%)	
80+	45 (8.2%)	8 (12.5%)	53 (8.7%)	
DK/missing	4 (0.7%)	2 (3.1%)	6 (1.0%)	
Gender of deceased				0.90
Male	286 (52.4%)	33 (51.6%)	319 (52.3%)	
Female	260 (47.6%)	31 (48.4%)	291 (47.7%)	
Education of deceased				0.64
No schooling	111 (20.3%)	14 (21.9%)	125 (20.5%)	
Primary (≤ 6 y)	111 (20.3%)	10 (15.6%)	121 (19.8%)	
Secondary (7-12 y)	95 (17.4%)	12 (18.8%)	107 (17.5%)	
Higher (>12 y)	58 (10.6%)	4 (6.2%)	62 (10.2%)	
DK/missing	171 (31.3%)	24 (37.5%)	195 (32.0%)	
Household wealth quintile				0.37
Lowest	110 (20.1%)	12 (18.8%)	122 (20.0%)	
Second	118 (21.6%)	20 (31.2%)	138 (22.6%)	
Middle	139 (25.5%)	13 (20.3%)	152 (24.9%)	
Fourth	80 (14.7%)	11 (17.2%)	91 (14.9%)	
Highest	99 (18.1%)	8 (12.5%)	107 (17.5%)	
Place of death				0.06
Health facility	308 (56.4%)	45 (70.3%)	353 (57.9%)	
Outside health facility	235 (43.0%)	18 (28.1%)	253 (41.5%)	
Refused/DK	3 (0.5%)	1 (1.6%)	4 (0.7%)	
Accidental death				0.22
Yes	25 (4.6%)	0 (0.0%)	25 (4.1%)	
No	520 (95.2%)	63 (98.4%)	583 (95.5%)	
Refused/DK	1 (0.2%)	1 (1.6%)	2 (0.4%)	
Deceased due to pregnancy complications*				0.13
Yes	1 (0.8%)	1 (7.2%)	2 (1.4%)	
No	82 (65.6%)	10 (71.4%)	92 (66.2%)	
Missing	42 (33.6%)	3 (21.4%)	45 (32.4%)	
Obs.	546	64	610	

Note: * female deaths aged 15-59 only.

Table C2 Logistic regression of death registration, overall and by gender of the deceased

	Full sample			Male sample	Female sample
	(1)	(2)	(3)	(4)	(5)
Gender of decease (ref: Male)					
Female	0.34***	0.35***	0.58*		
	(0.07)	(0.07)	(0.15)		
Timing of death (CMC)		0.99	1.00	1.00	1.00
		(0.01)	(0.01)	(0.01)	(0.01)
Age at death (ref: 15-59)					
60-79			2.61***	2.28*	3.85**
			(0.71)	(0.79)	(1.68)
80+			1.97	2.70	1.48
			(0.88)	(1.59)	(1.14)
Education of deceased (ref: No schooling)					
Primary (≤ 6 y)			3.00**	2.35	4.47**
			(1.09)	(1.54)	(2.21)
Secondary (7-12 y)			2.54*	2.92	2.03
			(1.08)	(2.05)	(1.23)
Higher (>12 y)			10.78***	12.83***	5.15
			(5.23)	(9.25)	(6.30)
DK/missing			2.50*	2.53	2.48
			(1.00)	(1.64)	(1.48)
Household wealth quintile (ref: Lowest)					
Second			1.35	1.52	0.96
			(0.54)	(0.82)	(0.69)
Middle			1.62	1.56	1.80
			(0.59)	(0.77)	(1.13)
Fourth			3.94***	4.40*	3.75*
			(1.59)	(2.58)	(2.36)
Highest			2.90**	2.32	4.29*
			(1.17)	(1.24)	(2.82)
Place of death (ref: Outside health facility)					
Health facility			2.00**	2.01*	2.15
			(0.47)	(0.59)	(0.86)
Obs.	452	452	452	236	216

Notes: The sample excludes deaths with unknown/missing information on death registration. Due to cell sizes, we also exclude respondents deceased before age 15 and with unknown information on age at death. Exponentiated coefficients; Standard errors adjusted for multiple deaths in households in parentheses. * $p<0.05$; ** $p<0.01$; *** $p<0.001$.