PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Mortality of Puerto Ricans in the United States Post-Hurricane Maria: An Interrupted Time Series Analysis
AUTHORS	Marazzi, Mario; Bobonis, Gustavo; Miloucheva, Boriana

VERSION 1 – REVIEW

REVIEWER	Eibich, Peter Max-Planck-Institut fur Demografische Forschung
REVIEW RETURNED	02-Nov-2021

GENERAL COMMENTS	Summary: This study estimates the changes in mortality rate and excess mortality of Puerto Ricans in the continental U.S. following Hurricane Maria in 2017. The authors combine monthly death counts from Vital Statistics with estimated monthly population numbers from the American Community Survey. They estimate a difference-in-differences model, which essentially compares changes in the mortality rate of Puerto Ricans with changes in mortality rates of Mexican and Cuban immigrants in the U.S. to account for time trends and seasonality effects. They find that in the six month period following the arrival of Hurricane Maria in Puerto Rico mortality rates for Puerto Ricans in the U.S. increased significantly, amounting to 514 excess deaths, which were concentrated among men and women aged 65 and above. Overall assessment: The paper is very well-written and makes an important contribution, by estimating the excess mortality of a natural disaster event among the (potentially) displaced population. The methods are appropriate and the analyses are well-executed. I only have a few comments aimed at improving the paper. Perhaps due to the brevity of the manuscript, the authors did not conduct some of the usual sensitivity analyses, and I think a more detailed discussion would improve the paper. Specific comments: 1. I think the paper could be improved by discussing previous estimates of the death toll in more detail. The authors mention and reference previous estimates, but there is no discussion on how these estimates were derived, and whether they attempt to account for estimates among the displaced population. Likewise, previous studies attempting to estimate population displacement seem relevant to this discussion. 2. I would have also liked to see a discussion of the potential mechanisms connecting the observed excess mortality to the natural disaster. I understand that the empirical analysis is limited due to the low number of death counts, but the authors could discuss plausible pathways, e.g., by referencing existing studies. In particular, I wondered to which extent the excess mortality might be due to a

	reversal of the “healthy migrant” effect – i.e., if previously mortality rates were higher in Puerto Rico than mortality rates of Puerto Ricans in the U.S. (e.g., because migrants tend to be healthier than the average population, or because conditions in the U.S. are more favourable), then large-scale displacement might lead to an increase in the mortality rate in the U.S. even though the mortality is not causally connected to the natural disaster (but the displacement would be, in this scenario). 3. The event-study framework used by the authors to estimate monthly changes in the mortality rate could in principle also be used to test whether the differences to the Mexican and Cuban population prior to the hurricane were statistically significant. Although the trends look largely parallel, there are some larger deviations, e.g., in January 2016, which raises the question whether the parallel trend assumption truly holds here. Alternatively, the authors could conduct placebo analyses to test for significant differences in the earlier period. 4. I think the authors should add more detailed notes to all tables. At current, it is not quite clear which numbers in the tables were observed, which were estimated in the main difference-in-differences model, and which were derived from other estimates. This is explained in detail in the online appendix, but because this is pertinent information I would encourage to include a short summary in the notes to each individual table.

REVIEWER	Howard, Jeffrey The University of Texas at San Antonio, Department of Public Health
REVIEW RETURNED	05-Nov-2021

GENERAL COMMENTS	I greatly appreciate the opportunity to review this manuscript. It addresses an important question that remains in the wake of the 2017 Hurricane Maria disaster regarding mortality of Puerto Rican migrants to the US following the hurricane. I think that the question is important, and the use of time series modeling is appropriate, I do have a few significant concerns. 1. The main methodological concern I have with this manuscript is that if I understand the author's analysis correctly, it relies on the comparison of mortality between all individuals of Puerto Rican background to the reference group of individuals of Mexican and Cuban background. Thus, the "excess" in mortality is relative to the mortality of Mexicans and Cubans. This is problematic because it assumes that prior to Hurricane Maria the mortality experienced by these groups is the same, which is a big assumption, and likely not true. 2. Another concern with the analysis is that it counts all deaths of individuals with Puerto Rican ethnic background in the numerator, but many, perhaps most, of these deaths were among individuals who had been on the mainland for a long time prior to Hurricane Maria, including many individuals who were born and raised on the mainland. Death certificate records provide information on the state of occurrence (where the death happened) and the state of residence (where the individual's residence was). In the case of migrants from Puerto Rico to the mainland in the months following Hurricane Maria, many would still have a primary residence of Puerto Rico, and so a cursory examination of the number of observed deaths among Puerto Ricans with a state of residence of Puerto Rico shows only 353 deaths with residence of Puerto Rico and occurrence on the mainland. This is not a foolproof method

	because some of the people could have already changed their residence status, but it suggests that the present analysis may be overestimating the excess deaths attributable to Hurricane Maria among Puerto Rican migrants. In addition, an examination of the birth state of each individual shows that about 6000 of the Puerto Rican individuals who died in 2017 were born on the mainland, around 500 or so deaths per month. At a minimum it raises serious questions about the methodology used to quantify excess deaths attributable to Hurricane Maria as it relates to migration from PR to the mainland. 3. Related to point 2, in Figure 1, we can see that there are prior periods with mortality rates are higher for Puerto Ricans than Mexicans and Cubans, so it is not clear that the observed differences in the months following Hurricane Maria are solely attributable to the Hurricane situation. 4. The limitation of including all individuals with Puerto Rican ethnicity in the numerator should be discussed in more detail, given that many of these individuals had likely been on the mainland prior to Hurricane Maria, and could have been experiencing excess mortality relative to Mexicans and Cubans for other reasons.

VERSION 1 – AUTHOR RESPONSE

Response to Comments by Referee 1

Thank you very much for the careful review and helpful feedback. Given your comments, we strengthened the paper in several ways. Below, we have included your original comments along with our responses.

> ***Overall assessment:*** *The paper is very well-written and makes an important contribution, by estimating the excess mortality of a natural disaster event among the (potentially) displaced population. The methods are appropriate and the analyses are well-executed. I only have a few comments aimed at improving the paper. Perhaps due to the brevity of the manuscript, the authors did not conduct some of the usual sensitivity analyses, and I think a more detailed discussion would improve the paper.*

Response: Thank you for the positive assessment of the paper. Indeed, due to the constraints on the length of the paper for submission to the journal, we did not include certain sensitivity analyses or discussion of pathways. As you will see in our responses below, we have done our best given the journal's constraints to include this additional detail.

> ***Comment (1):*** *I think the paper could be improved by discussing previous estimates of the death toll in more detail. The authors mention and reference previous estimates, but there is no discussion on how these estimates were derived, and whether they attempt to account for estimates among the displaced population. Likewise, previous*

studies attempting to estimate population displacement seem relevant to this discussion.

Response: Thank you for encouraging us to more clearly specify our contribution and relationship to the existing literature regarding estimates of displacement, mortality, and whether the excess mortality estimates in the literature take into consideration deaths among the displaced population. We aim to do so in the Discussion section, in the subsection titled *Contribution, Limitations, and Relationship to the Literature*.

We copy this discussion below for your convenience:

"The study contributes to the literature documenting the mortality consequences of Hurricane Maria in Puerto Rico. Several previous attempts to estimate the mortality effects of Hurricane Maria in Puerto Rico, including the official death toll estimate prepared by the Government of Puerto Rico, used Puerto Rico death registrar data and previous years' mortality rate estimates as a benchmark to identify periods of excess mortality in Puerto Rico.[7–11] Preferred mortality estimates for the six and seven-month period following the disaster—which considered only deaths registered in Puerto Rico despite significant population displacement and excluding deaths among the population displaced to the mainland —were as high as 2,975 and 3,400 respectively.[7,10] (We present a summary of the data, techniques, and treatment periods employed in this research in the Online Supplement.) This focus on deaths occurring in the territory resulted in an underestimation of the death toll by approximately 14.7%, which we estimate occurred in the United States. In contrast, Kishore et al. (2018) surveyed a representative sample of households, asking survivors to account for the whereabouts of all people who lived in their community prior to the Hurricane irrespective of the location of the occurrences of death among community members (on the island or elsewhere). Accordingly, they found a mortality rate that yielded an estimate of 4,645 excess deaths (95% CI 793-8,498) on account of Hurricane Maria. Our finding of excess mortality among the population of Puerto Rican origin in the mainland U.S. contributes to explaining the difference in estimates from these two methodological approaches.

An additional contribution of the study is the use of a research design to credibly estimate the excess mortality of displaced and migrant populations during this time period while carefully accounting for population displacement following the disaster. Using comparator populations of Cubans and Mexicans in the mainland U.S., our design robustly accounts for different population and mortality trends by age group and gender to account for both displacement and differential mortality among the Puerto Rican population. Our estimates of displacement of the population ages 65 and older of approximately 7.1 percent (40,700 individuals) is in line with the existing literature and supports the consensus using other methodologies that the natural disaster led to displacement in aggregate terms of approximately 4.1-5.6 percent of the total population of Puerto Rico.[17 ,18] This design, effectively used in related studies and other contexts to account for population movements, is broadly applicable both in other countries and in other disaster contexts (both natural and otherwise), particularly as displacement and mobility becomes an increasingly important feature of natural disasters.[18]"

Due to space limitations, we leave the more detailed discussion of displacement estimates to the Online Supplement.

Comment (2): *I would have also liked to see a discussion of the potential mechanisms connecting the observed excess mortality to the natural disaster. I understand that the empirical analysis is limited due to the low number of death counts, but the authors could discuss plausible pathways, e.g., by referencing existing studies. In particular, I wondered to which extent the excess mortality might be due to a reversal of the*

"healthy migrant" effect – i.e., if previously mortality rates were higher in Puerto Rico than mortality rates of Puerto Ricans in the U.S. (e.g., because migrants tend to be healthier than the average population, or because conditions in the U.S. are more favourable), then large-scale displacement might lead to an increase in the mortality rate in the U.S. even though the mortality is not causally connected to the natural disaster (but the displacement would be, in this scenario).

Response: Thank you for encouraging us to discuss potential pathways or mechanisms in more detail. We aim to address this in *two* ways. *First*, we estimate excess mortality levels by main cause of death in order to evaluate possible pathways connecting the observed excess mortality to the natural disaster. We conduct this analysis both for the overall population as well as for individuals ages 65 and older. We present this analysis in the Online Supplement (see Section B.5 and Table B.2), and summarize briefly in the Results section in the main text.

We copy the discussion of the results in the Online Supplement for your convenience:

> "Excess mortality was concentrated in deaths related to heart disease: the point estimates imply a ratio of observed to expected deaths of 1·06 among the overall population (95% CI 1·04 – 1·08) and of 1·11 among the adults ages 65 years and older (95% CI 1·07 – 1·14). In overall terms, we also estimate an increase in deaths due to diabetes and external factors; the ratio of observed to expected deaths are respectively 1·03 (95% CI 1·01 – 1·04) and 1·10 (95% CI 1·06 – 1·14). Among the old age population, the point estimates of the ratio of observed to expected deaths suggest increases in cancer (1·05 (95% CI 1·03 – 1·08)), diabetes (1·09 (95% CI 1·08 – 1·09)), and mortality related to other conditions (1·09 (95% CI 1·05 – 1·13)). Changes in mortality rates related to renal and respiratory conditions are positive but not significant at conventional confidence levels. These patterns are consistent with the distinct experiences that are specific to relocation among displaced populations such as additional psychological stressors and disruption in access to healthcare services as well as changes in their living conditions and social networks.[18,19]"

Second, we expand the Discussion section to address the interpretation of the results and highlight the study's limitations, which impede us from fully addressing your comment regarding the reversal of the "healthy migrant" effect.

We copy the statements in the Discussion section for your convenience:

> "Our study is informative regarding the broad mortality consequences of the disaster among the displaced and migrant population of Puerto Ricans in the U.S. This measure however limits our ability to quantify the elevated burden of disease from morbidity and disability among this population. We also face some limitations in our ability to precisely estimate cause-specific mortality or the causal pathways for such trends. Given the relatively small numbers of deaths in the population in the period under observation (monthly range 2,119–2,862), generating informative estimates of more finely defined cause-specific mortality is not feasible.

> Finally, because we use the deaths of persons who are identified as Puerto Rican in their death certificate, our analysis does not allow us to disentangle the excess mortality of displaced populations as opposed to longer-term migrants or second or third-generation individuals of such ancestry. Information on the deaths of Puerto Rico residents in the continental U.S. may be incomplete and/or prone to undercounting if the Puerto Rico residency status of such individuals is under-reported on death certificates. This phenomenon is particularly exacerbated among vulnerable, geographically mobile, migrant populations. Nonetheless, the fact our estimate is concentrated among vulnerable populations—consistent with the excess mortality estimates obtained for death occurrences in Puerto Rico—supports the view that we mainly capture excess deaths among the sizable population that was displaced to the mainland U.S. following the natural disaster. Future research could undertake epidemiological studies with micro-level data to precisely estimate cause-specific mortality, the causal pathways for such patterns, as well as mortality estimates that includes all hurricane-related deaths according to CDC guidelines for death occurrences in Puerto Rico and in the continental U.S."

We have made some back-of-the-envelope calculations to aim to answer your comment. The overall expected mortality rate during the Oct. 2017 - Mar. 2018 period among the Puerto Rican population in the mainland U.S. was approximately 2.36 per thousand, significantly lower than the expected mortality rate of individuals in the archipelago of Puerto Rico, estimated at approximately 4.36 per thousand individuals. We estimate smaller differences of 16.2 vs. 17.7 per thousand when we compare mortality rates among individuals ages 65 and older. If we assume that the excess mortality of the Puerto Rican population in the mainland U.S. during this period is driven solely by the displaced population—a strong assumption—we can provide an upper bound of the mortality rate among the old-age displaced population of 22.9 per thousand for men ages 65 and older and of 10.8 for women of these ages. However, because this analysis is at best suggestive and we have limited space to explain this thoroughly, we decided against including this in the discussion of results.

> ***Comment (3):*** *The event-study framework used by the authors to estimate monthly changes in the mortality rate could in principle also be used to test whether the differences to the Mexican and Cuban population prior to the hurricane were statistically significant. Although the trends look largely parallel, there are some larger deviations, e.g., in January 2016, which raises the question whether the parallel trend assumption truly holds here. Alternatively, the authors could conduct placebo analyses to test for significant differences in the earlier period.*

Response: Thank you for asking us to document the design's validity more thoroughly. We conducted placebo analyses to evaluate the validity of the research design – namely the lack of pre-event differential trends in mortality between the Puerto Rican and comparison populations in the mainland U.S. This analysis is reported in Section B.4 in the Supplemental Appendix. We refer the reader to this analysis in the exposition of mortality trends across groups (Figure 1) in the Results section (page 9), in footnote 6.

In the Supplemental Appendix, we include the following discussion:

“We implement a series of placebo tests to evaluate whether there are significant increases in mortality of the Puerto Rican population relative to that of the comparison group. We drop all data from the period September 2017 onwards, and then create 6-month treatment windows for each period on our sample to mirror our main analysis. We generate 68 placebo differences-in-differences estimates (for event windows starting in January 2012 until August 2018).

We compare our true estimate of the change in the mortality rate coefficients θs to the other placebo estimates obtained, reporting the percentile rank of the coefficient from the permutation test as well as the approximate p-value. In addition, we show histograms of the distribution of placebo-based results (see Figure B.1). We conduct this procedure both for the full sample of all adults as well as in the sample of individuals ages 65 and older.

The true estimate of θs (= 0.03732) for the period October 2017 – March 2018 is ranked first in the distribution of placebo estimates. Specific placebo estimates for the period Oct. 2013-Mar. 2014, Oct. 2014-Mar. 2015, and Oct. 2015-Mar. 2016, and Oct. 2016-Mar. 2017 are -0.0117, 0.0263, - 0.0113, and 0.0325, respectively. For the population of adults aged 65 and over, the true estimate of of θs (= 0.0682) is similarly ranked first in the distribution of placebo estimates. Overall, this analysis supports the assessment that there are common mortality trends across the two groups, and the large deviation takes place in a pronounced manner in the six-month window following the events.”

> ***Comment (4):*** *I think the authors should add more detailed notes to all tables. At current, it is not quite clear which numbers in the tables were observed, which were estimated in the main difference-in-differences model, and which were derived from other estimates. This is explained in detail in the online appendix, but because this is pertinent information I would encourage to include a short summary in the notes to each individual table.*

Response: Thank you very much for this comment. We have included notes to each table reporting the nature of each one of the summary statistics as well as identifying that most of the reported

statistics are based on OLS estimates of excess mortality rates based on equations 1 and 2 as reported in the paper. In general, we refer the reader to the Supplemental Appendix for details of the estimation of excess mortality by age group and gender and the aggregation procedure to estimate these for broader population groups.

Response to Comments by Referee 2

Thank you very much for the careful review and helpful feedback. Given your comments, we strengthened the paper in several ways. Below, we have included your original comments along with our responses.

> ***Comment (1):*** *The main methodological concern I have with this manuscript is that if I understand the author's analysis correctly, it relies on the comparison of mortality between all individuals of Puerto Rican background to the reference group of individuals of Mexican and Cuban background. Thus, the "excess" in mortality is relative to the mortality of Mexicans and Cubans. This is problematic because it assumes that prior to Hurricane Maria the mortality experienced by these groups is the same, which is a big assumption, and likely not true.*

Our apologies for being unclear about the research design and its underlying assumptions in the original submission. Our empirical strategy consists of a difference-in-differences design; specifically, we compare *differences* in the gender-by-age group stratum mortality rates of Puerto Ricans before and after September 2017 relative to the analogous difference for Cubans and Mexicans during the January 2012-December 2018 time period. In doing so, we effectively assume that the mortality trends of the Cubans and Mexicans by gender-age group stratum are an appropriate counterfactual for the seasonality and period-specific patterns of the Puerto Rican population while allowing for there to be differences in mortality *levels* across the treated and comparison groups.

We explore the mortality patterns in the data by reporting the *standardized* monthly mortality rate of Puerto Ricans vs. Cubans and Mexicans in the US in Figure 1, where August 2017 is used as the standard mortality rate for both populations. (Panel A shows the data for January 2012 to December 2018 whereas Panel B focuses on the period July 2017 to December 2018.)

It is true that the level of mortality is greater for Puerto Ricans than for Cubans and Mexicans throughout the period January 2012 to August 2017 (280·89 vs. 232·17 per 100,000, respectively). In spite of this difference in mortality levels, we show standardized trends in Figure 1 (standardizing the difference in mortality rates to zero in August 2017, the month before the hurricanes struck the island), the two groups experienced very similar mortality seasonal patterns and trends in the period up to September 2017, when Puerto Rico was severely affected by Hurricanes Irma and Maria.

Although we cannot formally test whether the mortality rate trends for Cubans and Mexicans are an appropriate counterfactual for the mortality trend of Puerto Ricans post -events, we

can explore the validity of the design indirectly. Following Reviewer 1's comment, we conducted placebo analyses to evaluate the validity of the research design – namely the lack of pre-event differential trends in mortality between the Puerto Rican and comparison populations in the mainland U.S. This analysis is reported in Section B.4 in the Supplemental Appendix. We refer the reader to this analysis in the exposition of mortality trends across groups (Figure 1) in the Results section (page 9), in footnote 6.

In the Supplemental Appendix, we include the following discussion: "We implement a series of placebo tests to evaluate whether there are significant increases in mortality of the Puerto Rican population relative to that of the comparison group. We drop all data from the period September 2017 onwards, and then create 6-month treatment windows for each period on our sample to mirror our main analysis. We generate 68 placebo differences-in-differences estimates (for event windows starting in January 2012 until August 2018).

We compare our true estimate of the change in the mortality rate coefficients θs to the other placebo estimates obtained, reporting the percentile rank of the coefficient from the permutation test as well as the approximate p-value. In addition, we show histograms of the distribution of placebo-based results (see Figure B.1). We conduct this procedure both for the full sample of all adults as well as in the sample of individuals ages 65 and older.

The true estimate of θs (= 0.03732) for the period October 2017 – March 2018 is ranked first in the distribution of placebo estimates. Specific placebo estimates for the period Oct. 2013-Mar. 2014, Oct. 2014-Mar. 2015, and Oct. 2015-Mar. 2016, and Oct. 2016-Mar. 2017 are -0.0117, 0.0263, - 0.0113, and 0.0325, respectively. For the population of adults aged 65 and over, the true estimate of of θs (= 0.0682) is similarly ranked first in the distribution of placebo estimates, and the distribution of placebo estimates is centered around zero. Overall, this analysis supports the assessment that there are common mortality trends across the two groups, and the large deviation takes place in a pronounced manner in the six-month window following the events."

Finally, we highlight that the inclusion of data for calendar year 2016 in the analysis, where we observe some minor deviations from common trends across the two groups, would lead to underestimation of the true increase in mortality of the Puerto Rican population as any excess mortality in the pre-period would be differenced out by the estimator. We believe that our results are thus conservative estimates of the increase in mortality among this population.

> ***Comment (2):*** *Another concern with the analysis is that it counts all deaths of individuals with Puerto Rican ethnic background in the numerator, but many, perhaps most, of these deaths were among individuals who had been on the mainland for a long time prior to Hurricane Maria, including many individuals who were born and raised on the mainland. Death certificate records provide information on the state of occurrence (where the death happened) and the state of residence (where the individual's residence was). In the case of migrants from Puerto Rico to the mainland in the months following Hurricane Maria, many would still have a primary residence of Puerto Rico, and so a cursory examination of the number of observed deaths among Puerto Ricans with a state of residence of Puerto Rico shows only 353 deaths with residence of Puerto Rico and occurrence on the mainland. This is not a foolproof method because some of the people could have already changed their residence status,*

but it suggests that the present analysis may be overestimating the excess deaths attributable to Hurricane Maria among Puerto Rican migrants. In addition, an examination of the birth state of each individual shows that about 6000 of the Puerto Rican individuals who died in 2017 were born on the mainland, around 500 or so deaths per month. At a minimum it raises serious questions about the methodology used to quantify excess deaths attributable to Hurricane Maria as it relates to migration from PR to the mainland.

Response: Thank you for this very important comment, which we had acknowledged in our research process but had not clearly expressed in the original submission. We are now upfront about this limitation in the Discussion section. Quoting from it: "[…] because we use the deaths of persons who are identified as Puerto Rican in their death certificate, our analysis does not allow us to disentangle the excess mortality of displaced populations as opposed to longer-term migrants or second or third-generation individuals of such ancestry. Information on the deaths of Puerto Rico residents in the continental U.S. may be incomplete and/or prone to undercounting if the Puerto Rico residency status of such individuals is under-reported on death certificates. This phenomenon is particularly exacerbated among vulnerable, geographically mobile, migrant populations." Nonetheless, the fact our estimated effects are concentrated among vulnerable populations— consistent with the excess mortality estimates obtained for death occurrences in Puerto Rico— supports the view that we mainly capture excess deaths among the sizable population that was displaced to the mainland U.S. following the natural disaster."

Even though we cannot disentangle effects among these distinct populations, the possible spillovers among non-displaced populations allow us to measure and understand more holistically the consequences of such natural disasters for these long-term resident populations. Due to space limitations, we do not delve into more detail of any possible distinction of effects among these populations. Also, please see the response to Reviewer 1's Comment 2 for some discussion of back-of-the-envelope estimates of bounds on mortality of displaced population based on some (unreasonably strong) assumptions.

Comment (3): *Related to point 2, in Figure 1, we can see that there are prior periods with mortality rates are higher for Puerto Ricans than Mexicans and Cubans, so it is not clear that the observed differences in the months following Hurricane Maria are solely attributable to the Hurricane situation.*

Response: Please see the response to Comment 1, where we aim to clarify the research design and concerns regarding the limited but possible existence of deviations from common trends in mortality rates between the Puerto Rican and Cuban/Mexican populations in the mainland U.S.

Comment (4): *The limitation of including all individuals with Puerto Rican ethnicity in the numerator should be discussed in more detail, given that many of these individuals had likely been on the mainland prior to Hurricane Maria, and could have been experiencing excess mortality relative to Mexicans and Cubans for other reasons.*

Response: Please see the response to Comment 2, where we point out the limitations of the study in the Discussion section (as well as in the article's summary of strengths and limitations).

VERSION 2 – REVIEW

REVIEWER	Eibich, Peter Max-Planck-Institut fur Demografische Forschung
REVIEW RETURNED	01-Mar-2022

GENERAL COMMENTS	I would like to thank the authors for addressing my previous comments. I am satisfied with the responses and think the paper has improved considerably. Upon re-reading the manuscript, I noticed one issue that I think warrants clarification before publication: 1. In Tables 1 and 2, the overall figure of excess deaths (514) and the number of observed deaths (14,010) are consistent. However, the disaggregated results by education in Table 3 do not seem to be consistent with the results reported for the overall age group of 65+ in Table 2 - the number of excess deaths appears to be much higher (805 vs. 596). I also noticed some discrepancies in the population figure and in the number of observed deaths. It would be helpful if the authors could clarify where this discrepancy comes from - is this related to missing data on education in some records, or is this a consequence of the estimation procedure?

REVIEWER	Howard, Jeffrey The University of Texas at San Antonio, Department of Public Health
REVIEW RETURNED	01-Mar-2022

GENERAL COMMENTS	I would like to thank the authors for addressing my previous comments. I am satisfied with the responses and think the paper has improved considerably. Upon re-reading the manuscript, I noticed one issue that I think warrants clarification before publication: 1. In Tables 1 and 2, the overall figure of excess deaths (514) and the number of observed deaths (14,010) are consistent. However, the disaggregated results by education in Table 3 do not seem to be consistent with the results reported for the overall age group of 65+ in Table 2 - the number of excess deaths appears to be much higher (805 vs. 596). I also noticed some discrepancies in the population figure and in the number of observed deaths. It would be helpful if the authors could clarify where this discrepancy comes from - is this related to missing data on education in some records, or is this a consequence of the estimation procedure?

VERSION 2 – AUTHOR RESPONSE

Response to Comment by Referee 1

Thank you very much for the helpful feedback. Below, we have included your comment along with our response.

Comment (1): *In Tables 1 and 2, the overall figure of excess deaths (514) and the number of observed deaths (14,010) are consistent. However, the disaggregated results by education in Table 3 do not seem to be consistent with the results reported for the overall age group of 65+ in Table 2 - the number of excess deaths appears to be much higher (805 vs. 596). I also noticed some discrepancies in the population figure and in the number of observed deaths. It would be helpful if the authors could clarify where this discrepancy comes from - is this related to missing data on education in some records, or is this a consequence of the estimation procedure?*

Response: Thank you for encouraging us to more clearly specify the differences in our results across specifications in Tables 2 and 3. Indeed, the cause of the discrepancy is related to missing data on educational attainment in death records as well as in population subgroup estimates.

In Table R1 (below), we compare our results from Table 2 (for all individuals ages 65 and older, presented in Panel A) to the estimates based on aggregating the data for individuals with any of the three educational attainment levels reported in Table 3 (presented in Panel B). The aggregate death counts are somewhat lower when we exclude cases with no reported education levels (113 fewer cases for men, 103 fewer cases for women), but also our estimates of the old age population (approximately 19,000 fewer men and 21,000 fewer women). Although these data differences lead to point estimates of excess mortality and excess deaths to be somewhat higher for the population of individuals 65 and older (see Panel B), there is significant overlap in the 95 percent confidence intervals using the two samples. Therefore, we cannot reject the hypothesis that the estimates of excess deaths are in the same range given the levels of precision.

We have also included a similar, more concise explanation as a footnote on page 14, which we provide below for your convenience:

> "We exclude deaths and population counts with missing educational attainment data from this particular analysis. Accordingly, excess mortality estimates for the group of individuals aged 65+ in Table 3 do not sum to the estimates reported in Panel C of Table
>
> 2. Nevertheless, given the level of precision of our estimates we cannot reject that these are in the same range."

Table R1: Comparison of Excess Mortality Estimates of the Puerto Rican Population Ages 65 Years and Older in the Mainland U.S. (October 2017 – March 2018), Excluding Individuals without Educational Attainment Information

	Δ Mortality			Excess	Ratio of Observed
Observed	Rate	Population	Expected	Deaths	to Expected
Deaths	[95% CI]	(100,000's)	Deaths	[95% CI]	Mortality [95% CI]

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Individuals ≥ 65 Years of Age						
(from Table 2)						
Men	4,249	0·073	2·222	3,950·9	298	1·08
		(0·008, 0·137)			(182, 414)	(1·04, 1·11)
Women	4,796	0·064	3·002	4,498·0	298	1·07
		(0·041, 0·088)			(250, 346)	(1·05, 1·08)
Panel B: Individuals ≥ 65 Years of Age						
(from Table 3 – aggregating across educational attainment categories)						
Men	4,136	0·113	2·203	3,694·7	441	1·12
		(0·070, 0·155)			(284, 598)	(1·07, 1·17)
Women	4,693	0·081	2·981	4,329·4	363	1·08
		(0·061, 0·101)			(277, 450)	(1·06, 1·11)

Notes: Column 1 reports observed deaths of the Puerto Rican population by gender in the mainland U.S., and column 3 reports estimates of the overall population of the respective group of Puerto Ricans in the mainland. Column 2 reports estimates of the difference in the natural logarithm of the mortality of Puerto Ricans relative to Cubans and Mexicans based on the aggregation of OLS estimates from equation 1 estimated for each gender-by-age group, as well as 95 percent confidence intervals in parentheses. Columns 4, 5, and 6 respectively report estimates of expected deaths, excess deaths, and the ratio of observed to expected deaths calculated from observed deaths (col. 1) and estimates of changes in mortality rates (col. 2); 95 percent confidence intervals of the level of excess deaths and of the ratio of observed to expected deaths are reported in parentheses.

VERSION 3 – REVIEW

REVIEWER	Eibich, Peter Max-Planck-Institut fur Demografische Forschung
REVIEW RETURNED	06-Apr-2022

GENERAL COMMENTS	Thank you very much for this clarification. My concerns have been addressed well, and I have no further comments. I recommend that the paper should now be accepted for publication.