

Article

The Enduring Demographic and Health Impacts of the Cambodian Genocide on Cambodia's Population

Erika Mey ^{1,*} and Rachel E. Goldberg ² ¹ Department of Health, Society & Behavior, Joe C. Wen School of Population and Public Health, University of California, Irvine, CA 92697, USA² Department of Sociology, School of Social Sciences, University of California, Irvine, CA 92697, USA; rachel.goldberg@uci.edu

* Correspondence: emey@uci.edu

Abstract

The Cambodian genocide occurred between April 1975 and January 1979. Over one-third of Cambodia's population perished, and many survivors suffer physical and mental health consequences. This study examines lasting influences of the Cambodian genocide on Cambodia's population structure and on adult health and health behavior. To illustrate the legacy of decreased fertility and increased mortality during the genocide, population pyramids (1975, 1985, 2014, 2022) were generated using data from the United Nations Population Division. For comparison, population pyramids for the neighboring country of Thailand were generated. To examine the enduring health sequelae of the genocide, nationally representative Demographic and Health survey data (2014, 2021–2022) were used to compare smoking behaviors and stunted growth of women born shortly before and during the genocide (1972–1979) with women born shortly after the genocide (1980–1987). Cambodia's population pyramids reveal a long-term paucity of individuals in the 1970s birth cohorts not observed for Thailand. Compared to women born shortly after the genocide, women with early-life exposure to the genocide were more likely to report smoking in adulthood and to have experienced stunted growth. The genocide impacted Cambodia's population structure and affected the health and health behaviors of early childhood genocide survivors into adulthood. These findings imply life course and intergenerational impacts.

Keywords: Cambodia; Cambodian genocide; genocide survivors; population structure; health; health behavior; smoking; stunted growth



Academic Editors: John R. Weeks and David Lopez-Carr

Received: 20 January 2026

Revised: 15 May 2026

Accepted: 17 June 2026

Published: 24 June 2026

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1. Introduction

The Cambodian genocide lasted for three years, eight months, and twenty days between April 1975 and January 1979 under the rule of communist leader Pol Pot [1,2]. This horrific period is sometimes referred to as the Khmer Rouge Era [2]. During this time, Cambodia and its people were brought to the brink of extinction [3]. Individuals targeted for execution included men, educated individuals or children from educated families, individuals living in urban areas, and people who were religious [4]. Mass destruction plagued the country, resulting in the obliteration of education, culture, currency, jobs, religion, and tradition to recreate Cambodia anew as an agricultural nation [1]. Approximately 1.2 to 3.3 million people died during this inhumane episode of history [5].

In addition to causing deaths, the genocide wrought a variety of physical and mental health impacts on survivors. Documented physical impacts included injuries, accidents,

and malnutrition as well as mental health conditions such as post-traumatic stress disorder and depression [6–9]. It is likely that the sequelae of some of these impacts span across the life course of individuals as well as across multiple generations [10].

Limited research has been conducted on the long-term demographic and health consequences of the Cambodian genocide [11]. In this study, we use population pyramids spanning four decades to illustrate the enduring impacts of Cambodia's genocide on the country's population structure. Multivariate analyses using data from the two most recent waves (2014 and 2021–2022) of the nationally representative Cambodia Demographic and Health Surveys (DHS) explore the enduring health sequelae of the Cambodian genocide, comparing the smoking behaviors and stunted growth of Cambodian adults with early-life exposure to the genocide (born 1972–1979) to individuals born shortly after the genocide (1980–1987). These two birth cohorts grew up during similar historical times, differing primarily in their genocide exposure. Overall, this study contributes to knowledge on the long-term population impacts of genocide using multiple methods and recent nationally representative data.

1.1. Previous Research: Impacts of the Genocide on Cambodia's Demographic Composition

Previously, studies have identified that extreme conflicts often result in an age-sex deficit in the population [12]. This may be evident due to a shortage of male and/or female children and adults, which can be attributed to high mortality, low fertility, and/or high out-migration rates during the time of conflict. These impacts alter the population structure over time.

1.1.1. Mortality

Mortality crisis was the most extreme consequence of the Cambodian genocide [13,14]. From 1975–1979, between 1.2 to 3.3 million people lost their lives directly or indirectly to the genocide [5,15,16]. Prior to the genocide, in 1974, the crude death rate was 22 deaths per 1000 population; as a result of the genocide, by 1975 the crude death rate had more than quadrupled to 86 deaths per 1000 population [17]. The increase in mortality is attributed to war violence, ethnic cleansing, and disease in addition to starvation, exploitation, population displacement, forced labor and mass execution [13]. Therefore, during the Khmer Rouge regime, excess mortality heavily affected Cambodia's population composition [14].

1.1.2. Fertility

Circumstances during times of turmoil also often lead to decreased births [13], and thus may alter fertility patterns [18]. Consistent with this, during the Khmer Rouge Era, fertility and marriage rates steeply declined [14]. Toxic stress and ongoing violence may have contributed to avoidance of fertility as well as difficulties conceiving a child or of carrying the pregnancy to term [12,18]. Severe malnutrition also suppresses fertility [19]. As one marker of altered fertility, Cambodia's crude birth rate decreased from 32 births per 1000 population in 1974 (pre-genocide) to 20 births per 1000 population in 1977; shortly after the genocide, in 1980, the crude birth rate increased to 47 births per 1000 [20].

1.1.3. Migration

During the time of the Cambodian genocide, internal migration reached unprecedented levels as cities were emptied in the early Khmer Rouge years and much of the rural population were also forcibly moved out of their villages [21]. An estimated two-thirds of the Cambodian population were involved in migration to rural areas [21]. By contrast, international migration in and out of the country were both relatively low during the years of the genocide. According to the United Nations Population Division, the crude rate of net migration between 1975 and 1977 did not exceed –10; toward the end of the genocide, in

1978, some additional out-migration led to a rate of -16 . The end of the genocide in 1979 was accompanied by a wave of returns (crude net migration rate of $+23$) and then by a wave of out-migration in 1980 (crude net migration rate of -26) [22]. Given the massive changes in mortality and fertility during the genocide, the relatively small shifts in international migration during the same period likely played a relatively small role in any shifts in the country's population structure.

1.2. Previous Research: Impacts of the Cambodian Genocide on Adult Health

A life course perspective can be useful to understanding the health and health behavior impacts of early exposure to the Cambodian genocide, as it facilitates consideration of the ways childhood experiences can influence an individual's health throughout their life course and into subsequent generations [23]. Adult health outcomes and health behaviors reflect experiences throughout an individual's life, including detrimental childhood exposures such as poverty, familial distress, violence, and food insecurity [24,25]. A related perspective is the Developmental Origins of Health and Disease (DOHaD), which links circumstances such as malnutrition and stress in the prenatal and developmental periods with later health outcomes [26].

Both frameworks suggest that early-life exposures to the physical and emotional traumas associated with the Cambodian genocide may be reflected in morbidities in adulthood. In this study, we investigate two health outcomes—smoking and stunted growth—that can be conceptualized as stemming from two genocide-linked factors: toxic stress and childhood malnutrition.

1.2.1. Toxic Stress and Smoking

Toxic stress from early childhood adversities and traumas has been linked to life-long developmental and behavioral consequences and to adverse mental and physical health outcomes, in part because it can alter the functioning of the brain, immune system, and other body systems [27–29]. Given the positive association between trauma symptoms and engagement with health risk behaviors observed in previous research [30], it is likely that the stress of early childhood exposure to the Cambodia genocide translates to increased likelihood of health risk behaviors in adulthood.

Smoking is a health behavior consistently linked to stress [31], as it serves as a problem-focused and emotion-focused coping mechanism [32]. Past research has linked higher levels of stress with higher risk of smoking cigarettes [33,34] and found that those who smoke are more likely to have mental health conditions such as depression and anxiety [35]. Individuals exposed to the Cambodian genocide during early childhood, who are likely to have experienced high levels of toxic stress, may thus in adulthood rely on smoking as one way of coping, which would suggest higher observed smoking rates relative to those without these early childhood exposures.

1.2.2. Malnutrition and Stunted Growth

The violence that ensued from the Cambodian genocide produced mass starvation throughout the country; uneven distribution of food rations further contributed to famine and malnourishment and starvation [9]. Given that the critical period for growth is between ages 0 and 2, a lack of nutritional intake in early childhood can lead to stunted growth [36,37]. Therefore, Cambodians who suffered from inadequate nutritional intake during early childhood and/or whose mothers experienced malnutrition while pregnant as a result of the genocide likely faced increased risk of long-term stunted growth [14]. Because of its long-term imprinting, stunted growth provides an important lens through which to understand the health impacts of early childhood exposure to the Cambodian genocide [14,37].

1.3. Research Questions and Hypotheses

To examine the enduring impacts of the genocide on the Cambodian population's demographic composition and health, we address the following research questions:

Research Question 1. Does Cambodia's age structure over time evince mortality and fertility patterns deriving from the Cambodian genocide?

Hypothesis 1. *Cambodia's population pyramids will show an absence of individuals in the birth cohorts most proximate to the genocide.*

Research Question 2. Are adults with early childhood exposure to the Cambodian genocide at higher risk of stunted growth and smoking than those born shortly afterwards?

Hypothesis 2. *Individuals born shortly before or during the time of the genocide will be more likely to smoke and to be of lower height in adulthood compared to their counterparts born shortly after the genocide.*

2. Materials and Methods

2.1. Part 1: Study Design

The first part of the study provides a visual representation of the impacts of the genocide on the country's population structure over time using population pyramids from 1975, 1985, 2014, and 2022. Comparisons between Cambodia and Thailand are made, given that Thailand is a neighboring country in the Southeast Asian region that did not experience genocide or war during this period. This approach allows for better isolation of impacts of the genocide on Cambodia's population composition.

2.1.1. Part 1: Data

Data for the population pyramids were retrieved from the Population Division of the United Nations' Department of Economic and Social Affairs [38]. We utilized sex-specific estimates of the Cambodian and Thai populations by five-year age group for the years 1975, 1985, 2014, and 2022. In their population estimation, the United Nations uses data from censuses, surveys, vital and population registers, analytic reports, and other sources to track demographic trends over time in each country, supplementing with post-enumeration surveys and making adjustments for under-enumeration as needed.

2.1.2. Part 1: Methodology

Population pyramids visually capture the age and sex composition of a given population at a point in time [39]. The x-axis represents the percentage of individuals in the population by age group, and the y-axis displays the age groups broken down in 5-year intervals [39]. Beyond showing a country's population composition at a point in time, population pyramids tell a story about shifts in the country's population over time. Because age can serve as a proxy for birth cohort, historical patterns of change in mortality, fertility, and migration are revealed.

We generated population pyramids for Cambodia and Thailand for the years 1975, 1985, 2014, and 2022. We selected these specific years because 1975 marks the initial year of the Cambodian genocide, 1985 marks one decade from the start of the genocide, and 2014 and 2022 align with the two most recent waves of DHS data available for Cambodia. We used the sex-stratified estimates of population to produce population pyramids for each year spanning ages 0–100+ in Excel.

2.2. Part 2: Study Design

The second part of the study uses multivariate analysis to compare the smoking status and height of individuals born shortly before and during the Cambodian genocide with those born shortly after the genocide. We compare individuals of the same age group (ages 35–42) in different survey years (2014 and 2021–2022), as well as individuals interviewed in the same survey wave who were born in different years (e.g., 1972–1979 vs. 1980–1987). The expectation is that health outcomes may vary based on genocide exposure, with age and survey year serving as means of proxying exposure to the genocide. We do not make comparisons to Thailand in these analyses because Thailand's last DHS survey was administered in 1987.

2.2.1. Part 2: Data

The Cambodia DHS is a nationally representative survey consisting of face-to-face interviews with women of reproductive age (primarily ages 15–49), face-to-face interviews with a sub-sample of men (ages 15–49), and household surveys capturing data on all household members. Data were retrieved from the individual and household surveys of the 2014 and 2021–2022 Cambodia DHS, the most recent survey waves. The analyses are limited to women because the DHS lacked data on smoking and height for the sub-sample of male respondents.

2.2.2. Part 2: Methodology

The strategy used to compare individuals born shortly before and during the genocide (who were exposed to the genocide at some point during the life stage of early childhood) with those born shortly after the genocide varies by outcome. Across analyses, age was used to determine whether the respondent was born before or during the genocide or shortly after the genocide ended. Because smoking prevalence likely decreased for all age groups between 2014 and 2021–2022, given declines in smoking globally in this period, within (between proximal age groups) as well as between-wave (35–42-year-olds in 2014 and 2021–2022) comparisons were drawn. For stunting, comparisons were only made between those aged 35–42 in 2014 and 2021–2022. Because stunting occurs in childhood, its prevalence is not expected to change for adults between the two survey waves.

For the analyses predicting smoking status, the analytic sample for the 2014 wave ($N = 11,277$) and the analytic sample for the 2021–2022 wave ($N = 13,625$) included women between the ages of 27–50. Three age groups were compared in the intra-wave analyses: 27–34, 35–42, and 43–50. The between-wave analyses included only the 35–42 age group. The breakdown of the analytic sample by age group for the 2014 wave was $N = 4998$ women aged 27–34, $N = 3142$ women aged 35–42, and $N = 3137$ aged 43–50. For the 2021–2022 wave, the breakdown was $N = 5380$ women aged 27–34, $N = 5352$ aged 35–42, and $N = 2893$ aged 43–50.

The analyses predicting stunted growth encompass only women ages 35–42 in each wave. The analytic sample ($N = 3091$) for the 2014 wave includes women between the ages of 35–42 in 2014, who were born between 1972–1979, shortly before the genocide began or during the time of the genocide. The analytic sample ($N = 5312$) for the 2021–2022 wave includes women between the ages of 35–42 at the time of the survey, born between 1980–1987, after the genocide.

For both outcomes, multivariate logistic regression was used to examine the health impacts of early exposure to the genocide. Sampling weights provided by the DHS were utilized to adjust for the sample design and survey non-response.

2.2.3. Part 2: Measures

Smoking was measured with a question asking, “Do you currently smoke cigarettes?” in 2014, and with a question asking, “Do you currently smoke cigarettes every day, some days, or not at all?” in 2021–2022. For each wave, smoking was coded as 0 if a woman did not currently smoke and 1 if a woman smoked at all at the time the survey was administered.

Height is included as a proxy for stunting stemming from malnutrition in early childhood. The interviewers measured the height of female respondents in centimeters. We defined stunted growth dichotomously as measuring under 150 cm (roughly 4 feet 11 inches) at the time of survey; this definition follows the stunting threshold used in previous scholarship on impacts of the Cambodian genocide [40].

Age was determined in both waves through a question asking, “In what month and year were you born?” For stunted growth, the age variable captured whether the individual was between the ages of 35 and 42 at the time of the survey wave. For smoking, three age groups were distinguished: 27–34, 35–42, and 43–50. Survey year was a binary independent variable distinguishing the 2014 wave from the 2021–2022 wave. Both age and survey year are the primary independent variables, used to capture early childhood exposure to the genocide.

The sociodemographic controls were selected based on previous literature [41,42]. We categorized marital status as never married, married, and widowed or divorced. Educational attainment was measured as the respondent’s highest level of schooling, which we categorized as no education/preschool, primary school, and secondary school or higher. The wealth index was generated by the DHS through a principal components analysis using information on household characteristics, consumer goods, and assets (e.g., ownership of vehicles, property, livestock, household appliances). The wealth index was divided into three categories labeled poor, middle, and rich.

3. Results

3.1. Demographic Composition: Comparisons Between Cambodia and Thailand

Figure 1 displays population pyramids for Cambodia and Thailand for the years 1975, 1985, 2014, and 2022. In 1975, the year the Cambodian genocide began, the population structures of Cambodia and Thailand were essentially the same. The roughly triangular pyramid shapes indicated young and growing populations in both countries. However, by 1985, deficits were visible in Cambodia’s population pyramid, with marked absences of girls and boys who would have been born shortly before or during the genocide (aged 5–9 in 1985), in addition to an increase in babies born after the genocide ended (aged 0–4 in 1985). In Thailand in 1985, there was no such major deficit in the 5–9 age range, nor a boom in the 0–4 age range.

In 2014, Cambodia’s population pyramid reveals an age-sex structure with a continuing deficit of individuals who would have born shortly before and during the time of the genocide. This can now be seen by comparing the 35–39 age group with the 30–34 age group. The rebound in the 30–34 age range reaffirms that tumultuous events resulting in substantial deaths were followed by immediate increased fertility shortly after the genocide ended [18]. This is also evident in the 2022 population pyramid for Cambodia, now among individuals between roughly the ages of 43–50, who would have been born a little before or during the genocide. By contrast, when examining the population pyramids for Thailand in 2014 and 2022, there were no obvious distinctions between these particular age groups; during this time, Thailand transitioned into a low fertility and low mortality stage of demographic transition while Cambodia did not. Overall, the population pyramids are consistent with severe child mortality and fertility impacts in Cambodia for the birth cohort

encompassing the time shortly before and during the genocide, and no such impacts in neighboring Thailand, which did not experience a genocide.

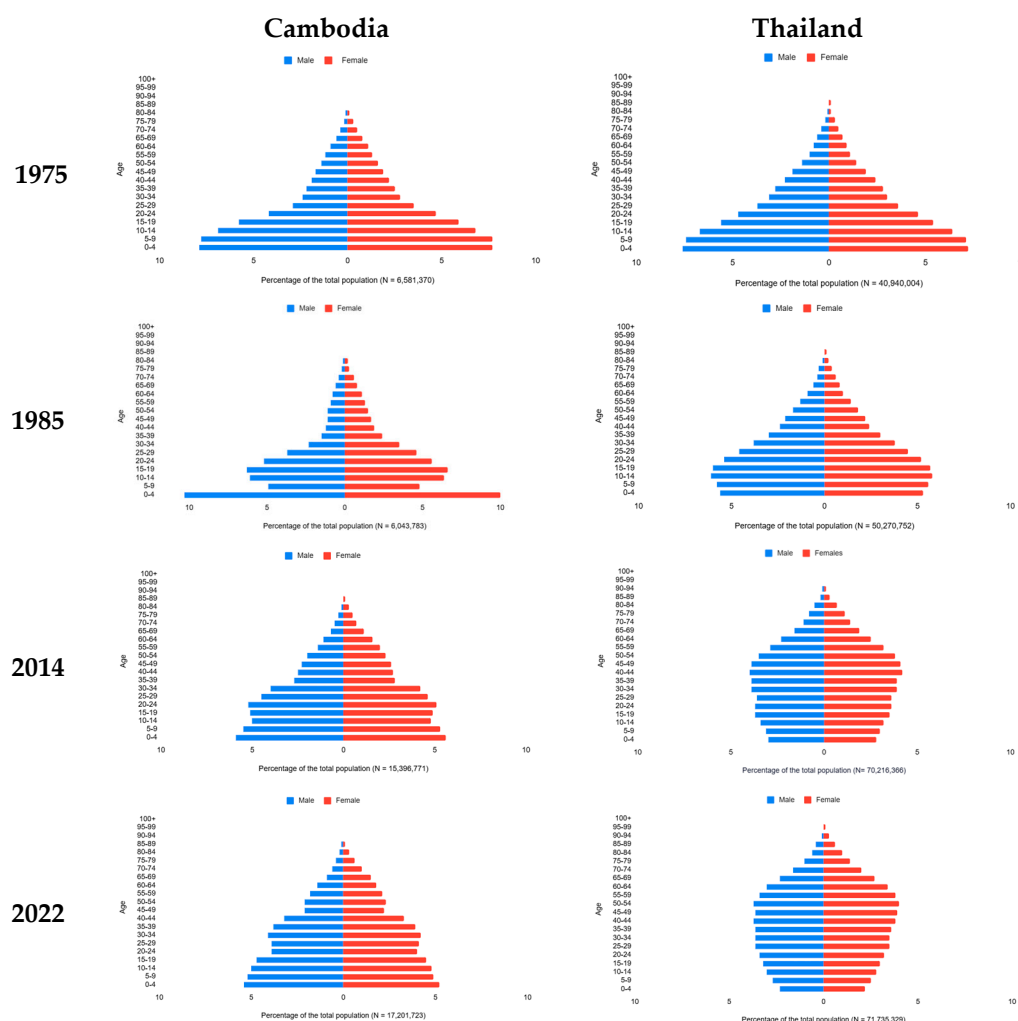


Figure 1. Age-Sex Structure Comparison: Population Pyramids of Cambodia and Thailand (1975, 1985, 2014, 2022).

3.2. Enduring Influences on Adult Health and Health Behavior

The population pyramids identified the birth cohorts that would have been born shortly before or during the genocide as ones that were particularly impacted. To examine the enduring health consequences of the genocide for those in these birth cohorts surviving to adulthood, Tables 1–5 present the results from bivariate and multivariate analyses comparing the risks of smoking and stunting between adults who were exposed to the Cambodian genocide in early childhood and those born shortly after the genocide ended.

3.2.1. Weighted Descriptive Statistics for Smoking

Table 1 presents results from weighted descriptive analyses for smoking among Cambodian women aged 27–50 by survey year. The overall prevalence for smoking among Cambodian women aged 27–50 was a little more than double in 2014 (3.07%) compared to 2021–2022 (1.29%).

Within each survey wave, differences in smoking prevalence between adjacent age groups can be observed. In 2014, a much larger share of women aged 35–42 (who lived through the genocide) reported smoking than women aged 27–34 (who were born shortly after the genocide) (4.23% vs. 1.71%). Similarly, in 2021–2022, roughly double the percentage

of women aged 43–50 (who experienced the genocide) reported smoking compared to women aged 35–42 (who were born shortly after the genocide) (2.86% vs. 1.31%).

Comparing the 35–42 age group across survey waves indicates similar results. The prevalence of smoking among women aged 35–42 in 2014, who were born before or during the genocide, was more than three times that of women aged 35–42 in 2021–2022, who were born shortly after the genocide (4.23% and 1.31%, respectively). Across all age groups, there was a general decrease in smoking between survey waves, consistent with declines in smoking globally.

Table 1. Weighted Descriptive Statistics for Smoking and Other Independent Variables among Cambodian Women Aged 27–50, by Survey Year.

	Total (N = 24,902)	
	Survey Year	
	2014	2021–2022
N	11,277	13,625
Smoking	3.07%	1.29%
Age Group		
Ages 27–34	44.32%	39.49%
Ages 35–42	27.86%	39.28%
Ages 43–50	27.82%	21.23%
Smoking Prevalence by Age Group		
Ages 27–34	1.71%	0.53%
Ages 35–42	4.23%	1.31%
Ages 43–50	4.14%	2.86%
Educational Attainment		
No Education/Pre-K	18.63%	16.78%
Primary	55.44%	46.22%
Secondary or Higher	25.93%	37.01%
Marital Status		
Never	7.61%	7.06%
Married	82.13%	84.56%
Widowed/Divorced	10.26%	8.38%
Wealth Index		
Poor	38.66%	35.71%
Middle	19.67%	19.27%
Rich	41.67%	45.03%

3.2.2. Weighted Logistic Regression for Smoking

Table 2 illustrates the results from the weighted logistic regression models for smoking among Cambodian women aged 27–50, stratified by survey year. The results reveal that women aged 27–34 in 2014 (born shortly after the genocide) were 60% less likely to report smoking compared to women aged 35–42 in 2014 (born shortly before or during the genocide) net of controls ($p < 0.001$). Similarly, women aged 43–50 in 2021–2022 (born shortly before or during the genocide) were 80% more likely to report smoking compared to women aged 35–42 (born shortly after the genocide) ($p < 0.05$). These results from 2014 and 2021–2022 data both indicate that women who were born shortly after the genocide ended were much less likely to smoke in adulthood than women who experienced the genocide in early childhood, despite being close to them in age. This reaffirms the take-away from the descriptive statistics that individuals exposed to the genocide during early childhood were more likely to smoke in adulthood compared to their counterparts who were not. Overall,

these findings are aligned with literature suggesting that smoking is a coping mechanism for early experiences of trauma and toxic stress [28].

Table 2. Weighted Logistic Regression for Smoking among Cambodian Women Aged 27–50, Stratified by Survey Year.

	2014				2021–2022			
	Odds Ratio	<i>p</i> -Value	95% CI		Odds Ratio	<i>p</i> -Value	95% CI	
Age Group								
Ages 35–42	1.00					1.00		
Ages 27–34	0.40	* 0.000	0.28	0.58	0.60	0.106	0.32	1.11
Ages 43–50	0.88	0.457	0.63	1.23	1.80	* 0.016	1.11	2.90
Educational Attainment								
No Education/Pre-K	1.00				1.00			
Primary	0.33	* 0.000	0.25	0.45	0.28	* 0.000	0.18	0.44
Secondary or Higher	0.23	* 0.000	0.13	0.42	0.08	* 0.000	0.02	0.26
Marital Status								
Never Married	1.00				1.00			
Married	2.81	* 0.040	1.05	7.56	0.74	0.531	0.29	1.91
Widowed/Divorced	1.71	0.335	0.57	5.11	1.02	0.972	0.33	3.11
Wealth Index								
Poor	1.00				1.00			
Middle	0.56	* 0.003	0.38	0.82	0.31	* 0.001	0.16	0.60
Rich	0.13	* 0.000	0.07	0.22	0.04	* 0.000	0.01	0.17
Constant	0.68	* 0.000	0.02	0.19	0.09	* 0.000	0.03	0.24

* $p < 0.05$.

Predicted probabilities were also obtained to illustrate the approximate likelihood of smoking between the groups of interest, with control variables held at their means. Figure 2 displays the predicted probabilities of smoking among Cambodian women for each of the three age groups, 27–34, 35–42, and 43–50. Although all groups had a low predicted probability of smoking, women aged 27–34 had the lowest probability of smoking, at just 0.005, aligning with the regression findings that women who were born shortly after the genocide were less likely than those exposed to the genocide to report smoking.

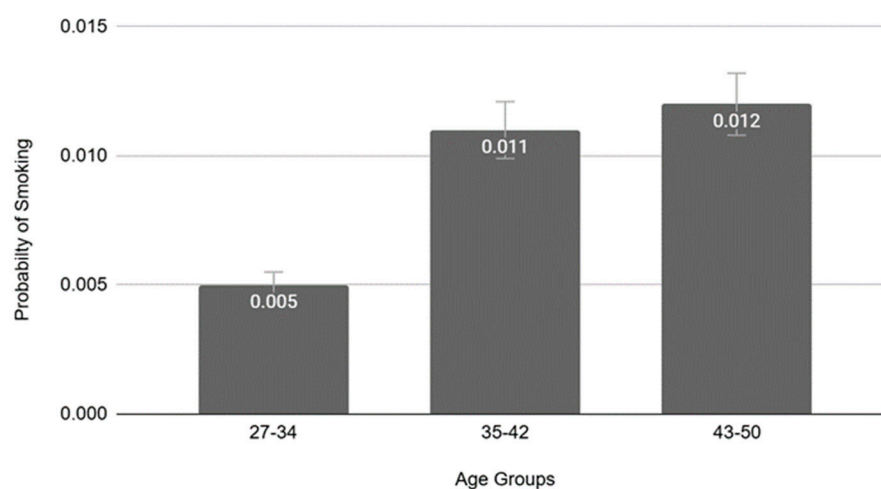


Figure 2. Predicted Probabilities of Smoking among Cambodian Women Aged 27–50.

Table 3 displays results from the weighted logistic regression for smoking among Cambodian women aged 35–42, pooling survey waves. The results reveal that women aged

35–42 in 2021–2022 (born shortly after the genocide) were 71% less likely to report smoking compared to women aged 35–42 in 2014 (born shortly before or during the genocide). This result is consistent with the idea that women exposed in early childhood to the genocide were more likely to smoke compared to their counterparts who were born after the genocide. However, this result is also consistent with a general decrease in smoking prevalence across time; thus, the findings should be taken together with the intra-wave results (Table 2) that also indicated higher rates of smoking at a single point in time among women exposed to the genocide relative to those close in age who did not have this exposure.

Table 3. Weighted Logistic Regression for Smoking among Cambodian Women Aged 35–42.

	Odds Ratio	<i>p</i> -Value	95% CI	
Survey Year				
2014	1.00			
2021–2022	0.29	* 0.000	0.20	0.44
Educational Attainment				
No Education/Pre-K	1.00			
Primary	0.25	* 0.000	0.17	0.38
Secondary or Higher	0.23	* 0.000	0.11	0.49
Marital Status				
Never Married	1.00			
Married	1.25	0.642	0.48	3.26
Widowed/Divorced	0.97	0.961	0.31	3.08
Wealth Index				
Poor	1.00			
Middle	0.34	* 0.000	0.18	0.62
Rich	0.10	* 0.000	0.05	0.21
Constant	0.18	* 0.000	0.07	0.47

* $p < 0.05$.

Figure 3 displays the predicted probabilities of smoking among Cambodian women aged 35–42 by survey year, 2014 and 2021–2022. Consistent with the regression results, women aged 35–42 in 2014, who were born shortly before or during the genocide, had a higher predicted probability of smoking compared to women aged 35–42 in 2021–2022, born shortly after the genocide.

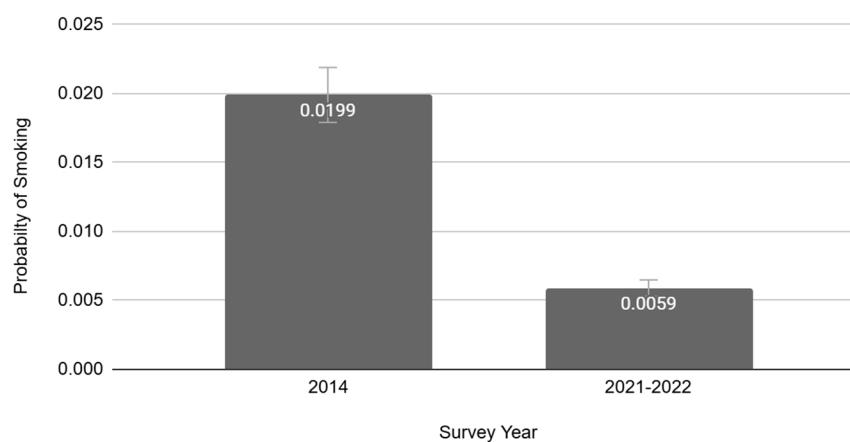


Figure 3. Predicted Probabilities of Smoking among Cambodian Women Aged 35–42, by Survey Year.

3.2.3. Weighted Descriptive Statistics for Stunted Growth

Table 4 illustrates results from the weighted descriptive statistics for stunted growth among Cambodian women aged 35–42 by survey year. The prevalence of stunted growth

was higher among women aged 35–42 in 2014 (27.71%), who were born shortly before or during the genocide, compared to women aged 35–42 in 2021–2022 (22.91%). This suggests that women exposed to the genocide experienced more malnutrition in early childhood compared to those born shortly after the genocide.

Table 4. Weighted Descriptive Statistics for Stunted Growth and Other Independent Variables among Cambodian Women Aged 35–42, by Survey Year.

	Total (N = 8403)	
	Survey Year	
	2014	2021–2022
N	3091	5312
Stunted Growth	27.71%	22.91%
Educational Attainment		
No Education/Pre-K	17.00%	19.36%
Primary	57.70%	52.27%
Secondary or Higher	25.30%	28.37%
Marital Status		
Never	5.82%	5.18%
Married	83.35%	86.39%
Widowed/Divorced	10.83%	8.43%
Wealth Index		
Poor	40.02%	35.34%
Middle	19.55%	19.25%
Rich	40.43%	45.41%

3.2.4. Weighted Logistic Regression for Stunted Growth

Table 5 shows results from the weighted logistic regression for stunted growth among Cambodian women aged 35–42, using pooled data from the 2014 and 2021–2022 DHS survey waves. In line with the descriptive results, results revealed that women aged 35–42 in 2021–2022 were 21% less likely to report stunted growth compared to women aged 35–42 in 2014, net of the other covariates ($p < 0.01$). This finding reaffirms that individuals exposed to the Cambodian genocide during early childhood were more likely to experience stunted growth than those born shortly after the genocide ended, likely as a result of malnutrition during the time of the genocide.

Table 5. Weighted Logistic Regression for Stunted Growth among Cambodian Women. Aged 35–42.

	Odds Ratio	<i>p</i> -Value	95% CI	
Survey Year				
2014	1.00			
2021–2022	0.79	* 0.001	0.69	0.91
Educational Attainment				
No Education/Pre-K	1.00			
Primary	1.02	0.850	0.85	1.21
Secondary or Higher	0.78	* 0.025	0.63	0.97
Marital Status				
Never Married	1.00			
Married	0.61	* 0.000	0.47	0.80
Widowed/Divorced	0.68	* 0.025	0.49	0.95
Wealth Index				
Poor	1.00			
Middle	0.86	0.112	0.72	1.04
Rich	0.73	* 0.000	0.62	0.86
Constant	0.73	* 0.047	0.54	0.996

* $p < 0.05$.

Figure 4 displays the predicted probabilities of stunted growth among Cambodian women aged 35–42 by survey year, 2014 and 2021–2022. In line with the results from the regressions, the predicted probability of stunted growth was higher (0.27) for women aged 35–42 in 2014, who were born shortly before or during the genocide, than for women aged 35–42 in 2021–2022 (0.23), born shortly after the end of the genocide.

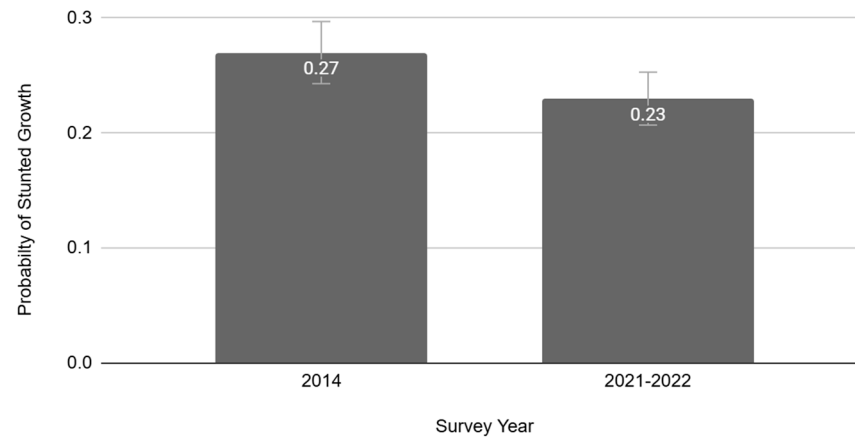


Figure 4. Predicted Probabilities of Stunted Growth among Cambodian Women Aged 35–42, by Survey Year.

4. Discussion

The purpose of this study was to examine the enduring consequences of the Cambodian genocide on Cambodia’s population with respect to population structure and adult health and health behavior. In the first part of the study, we hypothesized that Cambodia’s population pyramids in recent decades would show an absence of individuals in the birth cohorts most proximate to the genocide. Findings revealed a long-term paucity of individuals in the 1970s birth cohorts, with a population boom immediately following the genocide. This pattern was not observed for Thailand, a neighboring country that did not experience a genocide. Thus, differing from Thailand’s population structure over time, Cambodia’s demographic composition has persistently reflected increased child mortality and decreased fertility during the time of the genocide.

In the second part of the study, we hypothesized that individuals exposed to the Cambodian genocide in early childhood would have poorer health and health behavior outcomes in adulthood compared to their counterparts born shortly after the genocide ended. Specifically, we examined stunted growth as a reflection of early childhood malnutrition and smoking as a reflection of toxic stress. We found that women born shortly before or during the time of the genocide were both more likely to have stunted growth and to smoke than those born shortly after the genocide ended. Individuals born during or before the genocide likely experienced malnutrition and food insecurity themselves as children, and their mothers may have also experienced food insecurity while they were in utero; both may have rendered them more susceptible to experiencing stunted growth [9]. In relation to smoking, adults who experience a traumatic event such as the genocide at a young age may seek ways to cope with stress and one of these ways is through cigarette use [41]. Thus, smoking may serve as an enduring coping mechanism for toxic stress experienced during and as a result of the Cambodian genocide.

Overall, these results are consistent with prior research on the Cambodian genocide focusing on different age groups [43,44] in highlighting the immense consequences of the genocide on the Cambodian population. Our findings provide evidence that the aftershocks of the genocide can be felt across the life course and historical time in both population structure and individual-level health.

4.1. Limitations

This study has several limitations. Because of continued conflict and displacement in the years immediately following the Cambodian genocide, the birth cohort born in the years 1980–1987 is not a group unexposed to conflict. Rather, it is a group that, though not directly exposed to the genocide, may have been exposed to its aftershocks. As such, differences between the two adjacent birth cohorts may be a conservative estimate of the sequelae of the genocide. Moreover, the Cambodia DHS is a repeated cross-sectional survey, and therefore we are not able to prospectively examine the trajectories of individuals over time. As such, our results are largely descriptive and suggestive of long-term consequences. Longitudinal data stemming from the time of the genocide are not available to our knowledge.

In addition, the Cambodia DHS did not include data for male respondents for smoking behavior or height. Therefore, future research should attempt to validate these results with men and examine potential gender differences. Moreover, since the DHS data on smoking were collected through self-reports, there could also be some social desirability bias in reporting given that smoking may be a stigmatized behavior, especially among the younger age groups. There is no reason to believe, however, that this bias would differ by genocide exposure.

Survival bias is another limitation in studying the long-term health impacts of the Cambodian genocide on the Cambodian population [11]. The results from the DHS surveys are limited to those who survived the genocide and lived to the time of interview as well as those who were born after the genocide. Individuals who passed away during or after the genocide are not accounted for, although they are likely to have experienced greater health problems linked to the genocide; moreover, those who survived may have been particularly resilient. As such, the results presented are likely to represent an underestimate of the long-term sequelae of the genocide.

Importantly, the DHS surveys lacked detailed measures of chronic and mental health conditions and health behaviors, including but not limited to diabetes, hypertension, depression, anxiety and substance abuse. The inclusion of additional health measures would allow for further examination of the enduring consequences of the genocide. Prior research indicates that some mental health issues prevalent among Cambodians exposed to the genocide include anxiety, depression and post-traumatic stress disorder [6]. Given that the impacts of disasters extend beyond physical health [18], future research should, at a minimum, incorporate questions on mental health, a crucial aspect to learning about the Cambodian population's health outcomes as a result of the genocide.

Finally, future research should attempt also to formally decompose the relative contributions of delayed or foregone fertility, mortality, and international migration to the observed changes in population structure evident in the population pyramids. We lacked sufficient data to do so.

4.2. Implications

Given that children are among the most vulnerable populations [44,45], this research contributes to understanding of the long-term detrimental health and health behavioral impacts of early childhood exposures to war- and genocide-linked toxic stress and malnutrition. The findings may help inform program efforts for victims who remain in impacted countries as well as those who become refugees. Additionally, this study may serve as a basis for others to explore the long-term impacts of genocide and war on the populations of other countries of interest, such as Vietnam and Rwanda.

To fully understand the effects of the Cambodian genocide on long-term demographic and health outcomes, it would also be useful to include information on the children of survivors to document health impacts that may be intergenerational. Prior research has,

for example, revealed that women who experienced malnutrition during the genocide had children who later experienced stunted growth [46]. In this and other ways, residual trauma may be transmitted from one generation to the next. This study may thus serve as a foundation for future studies further examining the intergenerational aspect of genocide-linked health consequences.

5. Conclusions

The purpose of this paper was to examine how the Cambodian genocide influenced the mortality, fertility and morbidity of Cambodia's population over time. Results revealed that Cambodia's demographic composition was transformed over the long-term by genocide-linked changes in child mortality and fertility. Early childhood exposure to the genocide also impacted the long-term health outcomes of those surviving. Specifically, Cambodian women who experienced the genocide in early childhood reported higher rates of smoking and stunted growth than their counterparts born shortly after the genocide ended. Overall, the results made clear that the residual effects of the genocide have continued over time and across the life course, many decades after its formal end.

Author Contributions: Conceptualization, E.M. and R.E.G.; Methodology, E.M. and R.E.G.; Formal analysis, E.M.; Writing—original draft preparation, E.M.; Writing—review and editing, E.M. and R.E.G.; Supervision, R.E.G.; Project administration, E.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by a Robert Wood Johnson Foundation Health Policy Research Scholars award (No number).

Institutional Review Board Statement: Ethical review and approval were waived for this study because this work uses secondary de-identified data available from the Demographic and Health Surveys (DHS).

Informed Consent Statement: Informed consent was not required because this work uses secondary de-identified data available from the DHS.

Data Availability Statement: The age- and sex-specific population data presented in this study are available in the United Nations World Population Prospects repository at <https://population.un.org/wpp/>. Restrictions apply to the availability of the DHS data. Requests to access the DHS data should be directed to the DHS.

Acknowledgments: We would like to thank the DHS for providing access to the data on Cambodia.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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