



# Contribution of amenable mortality to life expectancy differences between the Dutch Caribbean islands of Aruba and Curaçao and the Netherlands

Soraya P.A. Verstraeten,<sup>1</sup> Hans A. M. van Oers,<sup>2</sup> and Johan P. Mackenbach<sup>3</sup>

**Suggested citation** Verstraeten SPA, van Oers HAM, Mackenbach JP. Contribution of amenable mortality to life expectancy differences between the Dutch Caribbean islands of Aruba and Curaçao and the Netherlands. *Rev Panam Salud Publica.* 2020;44:e38. <https://doi.org/10.26633/RPSP.2020.38>

## ABSTRACT

**Objective.** To identify specific health care areas whose optimization could improve population health in the Dutch Caribbean islands of Aruba and Curaçao.

**Methods.** Comparative observational study using mortality and population data of the Dutch Caribbean islands and the Netherlands. Mortality trends were calculated, then analyzed with Joinpoint software, for the period 1988–2014. Life expectancies were computed using abridged life tables for the most recent available data of all territories (2005–2007). Life expectancy differences between the Dutch Caribbean and the Netherlands were decomposed into cause-specific contributions using Arriaga's method.

**Results.** During the period 1988–2014, levels of amenable mortality have been consistently higher in Aruba and Curaçao than in the Netherlands. For Aruba, the gap in amenable mortality with the Netherlands did not significantly change during the study period, while it widened for Curaçao. If mortality from amenable causes were reduced to similar levels as in the Netherlands, men and women in Aruba would have added, respectively, 1.19 years and 0.72 years to their life expectancies during the period 2005–2007. In Curaçao, this would be 2.06 years and 2.33 years. The largest cause-specific contributions were found for circulatory diseases, breast cancer, perinatal causes, and nephritis/nephrosis (these last two causes solely in Curaçao).

**Conclusions.** Improvements in health care services related to circulatory diseases, breast cancer, perinatal deaths, and nephritis/nephrosis in the Dutch Caribbean could substantially contribute to reducing the gap in life expectancy with the Netherlands. Based on our study, we recommend more in-depth studies to identify the specific interventions and resources needed to optimize the underlying health care areas.

## Keywords

Health evaluation; quality indicators; health care; Aruba; Curacao; Netherlands.



In the Kingdom of the Netherlands, life expectancies are lower in the Dutch Caribbean islands of Aruba and Curaçao than in the Netherlands (1). A recent study demonstrated that, in contrast to the Netherlands, Aruba and Curaçao did not experience substantial improvements in cardiovascular mortality and have recorded increases in homicide and transport deaths during the period 1980–2014 (2). Although variations in mortality rates between populations are often the result of

complex interactions between many factors—for example, socioeconomic conditions, health behaviors, and environmental factors—there are indications that lack of access to quality health care services may also play a role.

Health care systems in the Kingdom of the Netherlands are built on the principle of solidarity and provide universal health care for its residents. General practitioners are the gatekeepers to health care services. In practice, this seems to work better in

<sup>1</sup> Institute for Public Health (Volksgezondheid Instituut Curaçao), Ministry of Health, Environment and Nature, Willemstad, Curaçao. ✉ Soraya P. A. Verstraeten, [s.verstraeten@vic.cw](mailto:s.verstraeten@vic.cw)

<sup>2</sup> Ministry of Health, Welfare and Sport, The Hague, the Netherlands

<sup>3</sup> Department of Public Health, Erasmus MC, Rotterdam, the Netherlands

the Netherlands than in Curaçao (3). While equal access to the system has, by and large, been achieved in the Netherlands (4), this was less the case in Curaçao: despite much higher morbidity rates, people with a lower educational level in Curaçao were less likely to have consulted a specialist and to have been hospitalized than those with a higher educational level (5). Part of the explanation was that waiting times for specialist care were longer for low-income patients (whose insurance payment model was based on a capitation fee) than for private patients (whose insurance payment model was based on fee-for-service) (6). Differences in payment models and waiting times have fundamentally improved with the introduction of the basic health care insurance in 2013 (7), but the results of a recent health survey showed that the consumption of specialist care did not reflect levels of morbidity (8). This may imply a continuation of undertreatment of those who need medical services the most, but can also suggest that overtreatment is common. Supporting this is the much higher utilization of general practitioner services (9, 10) and prescription medications (11) compared to the Netherlands. No information on the accessibility and consumption of health care services was available for Aruba.

Next to accessibility, the legal framework regulating health care quality lags behind in the Dutch Caribbean. Thirteen years after the introduction of the Individual Healthcare Professions Act (the so-called BIG-wet) in the Netherlands, which regulates the qualification of health care professionals, a similar law was proclaimed by the Curaçaoan parliament (2010). The underlying provisions have, however, not yet been implemented. Aruba proclaimed a similar law, the AruBIG, in 2014. In the same year, Aruba also introduced legislation regulating the quality of health care providers, which is not foreseen in Curaçao for the near future.

Outcomes of health care services are not routinely monitored in the Dutch Caribbean, and the islands have limited research capacity. This demonstrates that policymakers' needs for relevant and timely information to identify issues, set priorities, support practices, and monitor progress to support health planning activities are not met. This study is an initial step and aims to identify health care areas whose optimization could improve population health in Aruba and Curaçao. The results will enable local governments to prioritize health care areas where improvements are possible and necessary.

Using the concept of amenable mortality, a widely adopted measurement of deaths that are considered unnecessary in the presence of timely and effective health care, this comparative observational study assesses the contribution of health care to the lower life expectancies in the Dutch Caribbean. Specifically, we aimed to 1) quantify differences in amenable and non-amenable mortality trends for Aruba, Curaçao, and the Netherlands during the period 1988–2014, and 2) estimate the contribution of amenable causes to life expectancy differences between the Dutch Caribbean islands and the Netherlands during the period 2005–2007. Then, the results are discussed from a substantive perspective in light of health indicators and country reports.

## METHODS

### Data

Mortality data were obtained from the World Health Organization (WHO) mortality database or through a request to the Pan

American Health Organization (PAHO) for Curaçao (12). Subject to data availability, data of the Netherlands for the period 1988–2014, of Aruba for 1999–2014, of the Netherlands Antilles for 1988–1999, and of Curaçao for 2000–2007 were included. Data depict annual deaths by sex and age in each year, using the tenth revision of the International Classification of Diseases (ICD-10). Population data by sex and age were extracted from the United Nations World Population Prospects (WPP) 2017 (1). Data sources of health indicators from the Netherlands, Aruba, and the Netherlands Antilles/Curaçao are listed in the notes of Table 3.

### Data adjustments

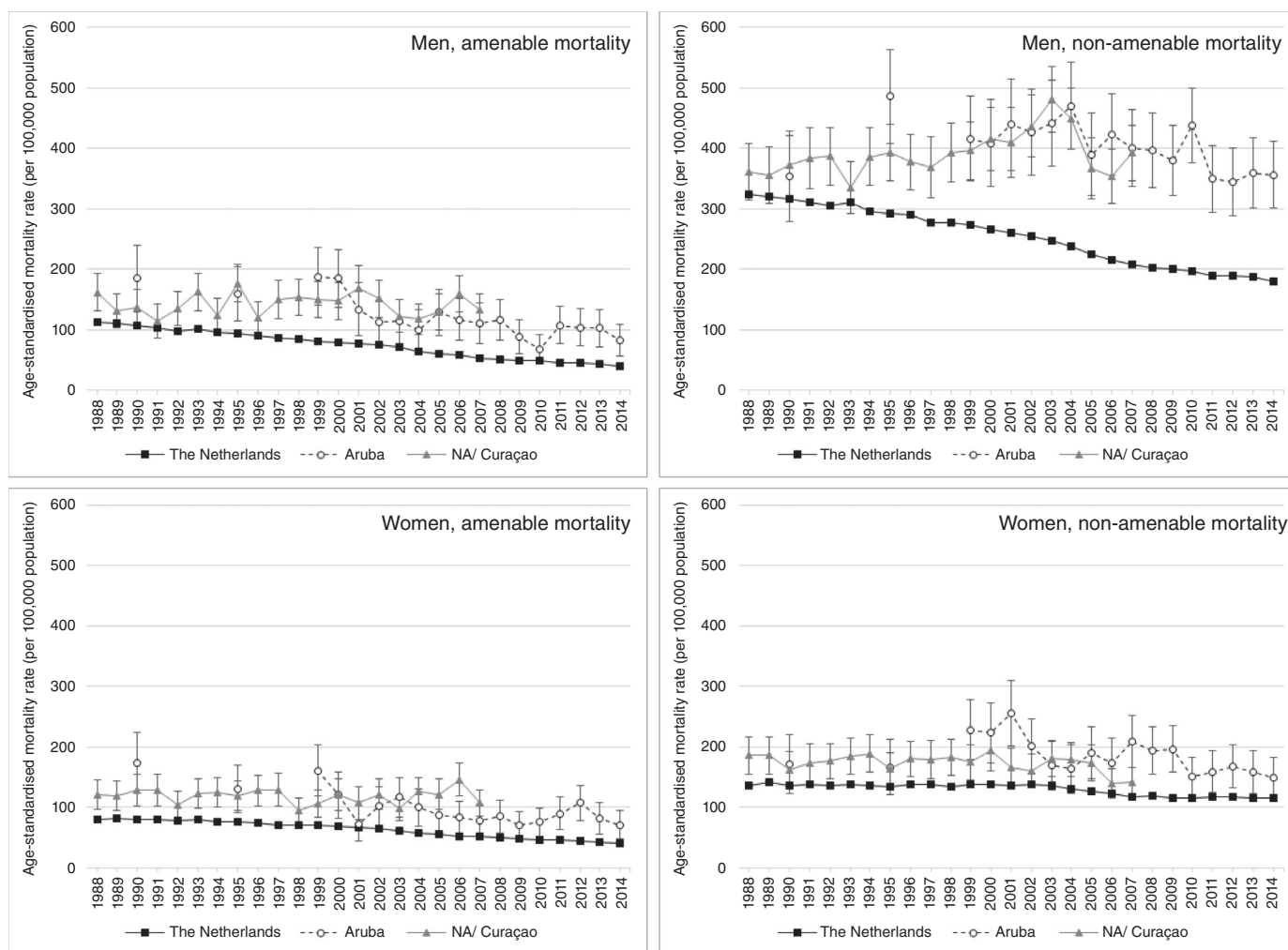
ICD-10 codes followed the classification of amenable deaths used by Nolte and McKee (13). Deaths were corrected for unclassified age and sex, for deaths attributed to ill-defined causes (R00–R99, non-external deaths only), and for under-registration (14), as determined by comparing the number of deaths with independent estimates from the WPP 2017 (1). Based on the corrected numbers of deaths, we calculated age-standardized mortality rates per 100 000 population using direct standardization to the world standard population (15). Data of the Netherlands Antilles (which consisted of five island territories and was dissolved in 2010) and Curaçao (the most populous island territory of the former Netherlands Antilles accounted for 75% of the population) were depicted as a continuous trend, since analyses showed a continuance of mortality trends between the Netherlands Antilles (NA) (1988–2000) and Curaçao (2001–2007). We refer to these territories as NA/Curaçao.

### Data analyses

For each territory, the annual percentage change in mortality trends during the period 1988–2014 were determined using Joinpoint software (version 4.2.0, National Cancer Institute, Bethesda, MD). A minimum number of 0 and a maximum number of 3 joinpoints were supplied and homoscedasticity was assumed. Life expectancies were computed using abridged life tables for the most recent available data for a three-year period, i.e., 2005–2007. To this end, population data and the corrected number of deaths from each territory were totaled to reduce sensitivity to small number fluctuations. Next, life expectancy differences between the Dutch Caribbean islands and the Netherlands were decomposed into cause-specific contributions using Arriaga's method. Calculations were performed using the Excel-template of Auger et al. (16). All datasets contain aggregate data unrelatable to identifiable persons.

## RESULTS

Figure 1 demonstrates that the differences in amenable and non-amenable mortality between the Netherlands and the Dutch Caribbean islands were substantial. From 1988 through 2014, both amenable and non-amenable mortality decreased steadily in the Netherlands, more rapidly for men than for women. In Aruba and NA/Curaçao, trends have taken a more fluctuating course due to their small populations, but levels of amenable and non-amenable mortality have been consistently higher than in the Netherlands.

**FIGURE 1. Trends in age-standardized mortality rates for amenable and non-amenable causes for Aruba, the Netherlands Antilles (NA)/Curaçao, and the Netherlands, ages 0–74 years, 1988–2014**

Source: Author's own calculations.

According to the results of the Joinpoint analyses (Table 1), amenable mortality has declined more rapidly than non-amenable mortality in all constituent countries, with the exception of women in NA/Curaçao. Despite the strong fluctuations between 1999 and 2014, the overall trend in amenable mortality in Aruba has been downwards. A comparison of the slopes yielded non-significant results for both sexes; i.e., the annual percentage changes were statistically not significantly different between Aruba and the Netherlands. Consequently, the gap in amenable mortality between Aruba and the Netherlands did not significantly widen or narrow during the study period.

NA/Curaçao experienced a non-significant decline in amenable mortality rates during the period 1988–2007 for both sexes. A comparison of the slope with that of the Netherlands yielded significant results for both sexes, indicating that the annual percentage changes are different between the Netherlands and NA/Curaçao. In contrast to the Netherlands, the NA/Curaçao population did not experience a decline of amenable mortality during the study period, so that the gap in amenable mortality with the Netherlands widened.

Table 2 shows how much separate amenable causes of death contributed to the difference in life expectancy between the Netherlands and the Dutch Caribbean islands during the latest time period for which data for all three constituent countries are available, i.e., 2005–2007. In Aruba, amenable mortality accounts for 19% (men) and 17% (women) of the total mortality gap with the Netherlands. For NA/Curaçao this is substantially more, with 37% and 75%, respectively.

If mortality from amenable causes were reduced to similar levels as in the Netherlands, men and women in Aruba would add, respectively, 1.19 years and 0.72 years to their life expectancies. In Curaçao, this would be 2.06 years and 2.33 years. Mortality improvements for amenable circulatory causes (which includes ischemic heart disease, cerebrovascular disease, and hypertensive disease) to the level of the Netherlands would add respectively 1.02 years and 0.56 years to the life expectancy of men and women in Aruba. In NA/Curaçao, this would be 0.65 years and 0.55 years. Perinatal deaths are an important additional contributing cause of death in NA/Curaçao, and are responsible for 0.79 years (men) and 0.90 years (women) of the

**TABLE 1. Results of Joinpoint software analyses of trends for amenable and non-amenable mortality for Aruba, the Netherlands Antilles (NA)/Curaçao, and the Netherlands. Comparison of the Netherlands with Aruba is based on data from the period 1999–2014; comparison of the Netherlands with NA/Curaçao is based on data from the period 1988–2007.**

	Amenable mortality		Non-amenable mortality	
	Trend APC	Test for parallelism	Trend APC	Test for parallelism
<b>Men</b>				
The Netherlands	-4.72*	0.422	-2.88*	0.007
Aruba	-3.99*		-1.40*	
The Netherlands	-3.57*	0.000	-2.20*	0.000
NA/Curaçao	-0.05		0.68*	
<b>Women</b>				
The Netherlands	-3.64*	0.449	-1.49*	0.129
Aruba	-2.79*		-2.50*	
The Netherlands	-2.37*	0.002	-0.52*	0.415
NA/Curaçao	-0.18		-0.74*	

APC annual percentage change

Notes: \* significant trend change, APC is significantly different from zero (two-side  $p < 0.05$ )

Source: Author's own calculations.

**TABLE 2. Results of Arriaga's decomposition method analyses of life expectancy differences between the Dutch Caribbean islands of Aruba and Curaçao and the Netherlands, 2005–2007**

	Men		Women	
	Aruba	Curaçao	Aruba	Curaçao
<b>Difference in life expectancy (years) with the Netherlands due to:</b>				
All causes of death	6.24	5.62	4.12	3.10
Non-amenable causes	5.05	3.57	3.41	0.77
Amenable causes	1.19	2.06	0.72	2.33
% of the difference due to amenable causes	19.1	36.6	17.4	75.1
<b>Amenable causes</b>				
Infectious diseases	0.01	0.01	0.01	0.00
Treatable cancers, among which:	0.05	0.04	0.18	0.35
- Colon and rectum	0.03	0.08	-0.08	0.10
- Breast	--	--	0.22	0.21
- Cervix and uterus	--	--	0.01	0.01
Diabetes	0.00	0.03	0.05	0.08
Ischemic heart disease (50% of deaths)	0.33	0.22	0.12	0.15
Cerebrovascular disease	0.34	0.20	0.32	0.20
Respiratory diseases	0.03	0.07	-0.06	0.06
Digestive diseases	0.00	-0.01	0.01	0.01
Perinatal deaths	0.09	0.79	-0.10	0.90
Other amenable conditions, among which:	0.34	0.40	0.19	0.58
- Hypertensive disease	0.35	0.23	0.12	0.20
- Nephritis and nephrosis	0.03	0.12	0.02	0.21

Source: Author's own calculations.

total mortality gap with the Netherlands. Nephritis/nephrosis is also important, especially for NA/Curaçao. In addition, reduction in breast cancer mortality to the level of the Netherlands would add 0.22 years in Aruba and 0.21 years in NA/Curaçao to female life expectancy.

## DISCUSSION

The results show that deaths from amenable causes substantially contribute to the life expectancy differences between the Caribbean islands of Aruba and NA/Curaçao and the

Netherlands. In Aruba, amenable deaths comprise 19% (men) and 17% (women) of the total life expectancy difference with the Netherlands. In NA/Curaçao, this is 37% and 75% respectively. The larger relative contribution of amenable deaths in NA/Curaçao is mainly due to its relatively high mortality from perinatal causes and nephritis/nephrosis. As the contribution in years is comparable between men and women in NA/Curaçao, the large sex difference is explained by the relatively large contribution of non-amenable mortality among males. Non-amenable mortality rates were also higher in the Dutch Caribbean islands than in the Netherlands, especially for men,

**TABLE 3. Overview of comparable health indicators for Aruba, the Netherlands Antilles (NA)/Curaçao, and the Netherlands**

	Year	The Netherlands	Aruba	NA/Curaçao
<b>Cancer care</b>				
Participated in screening of: <sup>1</sup>	Ca. 2017			
- Cervix cancer		56.9	-	48.9
- Breast cancer		77.3	-	43.3
- Colon cancer		72.7	-	25.4
Mortality-to-incidence ratio: <sup>2</sup>	2005–2010 (latest available)			
- Cervix		0.28	0.32	0.33
- Breast		0.21	0.29	0.28
- Colon and rectum		0.40	0.39	0.47
<b>Mother-and-child care</b>				
Maternal mortality (per 100 000 births) <sup>3</sup>	2003–2007	6.0	16.4	47.2
Immunization coverage <1 year (%) <sup>4</sup>	2016			
- DTP3 and polio 3		93.5	(97.0)	85.0
- PCV3		93.6	(93.0)	74.0
- MMR 1		90.9	(97.0)	78.0
<b>Noncommunicable diseases</b>				
Kidney dialysis patients, per 100 000 population <sup>5</sup>	2014	38.3	-	163.9

**Source:**

- <https://www.volksgezondheidszorg.info/onderwerp/bevolkingsonderzoek>; Curaçao, Volksgezondheid Instituut Curaçao (2017) De Nationale Gezondheidsenquête.
- Morbidity data. The Netherlands (2019) <https://www.cijfersoverkanker.nl>; Aruba, Ministry of Public Health and Sports (2013) Health Monitor Aruba; Curaçao, Volksgezondheid Instituut Curaçao (2014) Gezondheidsdatabank. Mortality data. WHO mortality database, April 2018 update. Available from: [https://www.who.int/healthinfo/mortality\\_data/en/](https://www.who.int/healthinfo/mortality_data/en/)
- World Health Organization. WHO mortality database, April 2018 update. Available from: [https://www.who.int/healthinfo/mortality\\_data/en/](https://www.who.int/healthinfo/mortality_data/en/)
- The Netherlands, RIVM (2016) Vaccinatiegraad Rijksvaccinatieprogramma Nederland; Aruba and Curaçao, PAHO PLISA database (2019) <https://www.paho.org/data/index.php/en/indicators/visualization.html>
- The Netherlands, Nefrodata (2019) <https://visualz.nl/visualz/chartFlash/charts>; Curaçao, Volksgezondheid Instituut Curaçao (2014) Gezondheidsdatabank.

for whom the gap with the Netherlands has strongly diverged during the study period. A previous study showed that the divergence of non-amenable mortality was largely due to increased mortality from homicide and transport accidents (2).

All in all, amenable mortality plays a larger role in the life expectancy gap with the Netherlands for NA/Curaçao than for Aruba. Ischemic heart disease, cerebrovascular disease, hypertensive disease (hereafter circulatory diseases), and breast cancer are the underlying causes of death with the largest contribution to life expectancy differences with the Netherlands. In NA/Curaçao, perinatal deaths and nephritis/nephrosis also play a role. Medical interventions that help to prevent deaths from these causes have been comprehensively described elsewhere and are briefly summarized here (17). Increased detection efforts for hypertension, improvements in the treatment of hypertension from the 1950s onwards, and the intensive management of stroke in coronary care units, have significantly reduced mortality from circulatory diseases. Breast cancer mortality declined after the introduction of population screening programs (mammography) and treatment with tamoxifen, even though the effectiveness of the first intervention remains a topic of dispute (18). Declines in deaths from perinatal causes have been the result of advances in the treatment for specific conditions, such as rhesus immunization and surfactant, and the incremental introduction of a wide range of interventions, such as special baby care units, and local intensive and ventilator care. The key interventions in reducing deaths from nephritis/nephrosis were dialysis and renal transplantation, and graft survival for the latter treatment was further improved after the introduction of ciclosporin in the 1980s.

Based on the available health indicators (Table 3) and information from country reports, there are several indications that patients with these disorders, or their underlying risk factors, do not receive adequate curative and preventive care in the Dutch Caribbean. During a health examination survey in Curaçao, blood pressure control was 32% among respondents that were previously diagnosed with hypertension (8). While data from the Netherlands were not directly comparable because of different study methods, control of hypertension appears substantially higher among Dutch men (53%) and women (61%) in Amsterdam (19). Among diagnosed diabetics in Curaçao, 35% had a normal blood glucose level (8), whereas 67% of diabetic men and 47% of diabetic women in Amsterdam had HbA1c levels on target, which suggests that blood glucose control is also less favorable in Curaçao (20). This demonstrates that the prevalence of uncontrolled hypertension and diabetes, and subsequently the proportion of people that are at risk for related complications such as nephritis/nephrosis, is relatively high in Curaçao. Information on hypertension or blood glucose control in Aruba was not available.

Moreover, in order to prevent complications, it is recommended that patients with diabetes have regular eye and foot examinations (Dutch College of General Practitioners (NHG) guidelines). In 2017, 67% of diabetics in Curaçao had undergone a clinical eye examination in the past two years, and 29% had undergone a clinical foot-examination, a drop of 9% and 7%, respectively, compared to 2013 (8). A severe complication of untreated diabetes is kidney disease. As another indication that the detection and/or treatment of diabetes is inadequate in Curaçao, the proportion of dialysis patients was four times higher than in the Netherlands (Table 3). Concerns about an



alarmingly high number of complications related to diabetes were confirmed in Aruba as well (21). Further investigation should ascertain whether the differences in nephritis/nephrosis mortality between Aruba and Curaçao are due to an increased effectiveness of chronic disease care in Aruba that prevents the severe complications from hypertension and diabetes, or are, for example, the result of different practices in the diagnosis and treatment of renal failure.

A national breast screening program was introduced in the Netherlands in 1989. In NA/Curaçao, a similar program was initiated by a private foundation in 2010, and only received financial support from the local government in 2017. A national breast screening program was introduced in Aruba in 2016. In 2017, breast cancer screening rates in Curaçao were lower than in the Netherlands, which may partially explain the higher mortality-to-incidence ratios on the island (Table 3). Information on breast cancer screening rates were not available for Aruba. No information on the effectiveness of breast cancer treatment in the Dutch Caribbean was available, as cancer survival rates are not published by local hospitals.

Curaçao also struggles with providing sufficient coverage in other areas of preventive care. For cervix and colorectal cancer, relatively low screening rates and high mortality-to-incidence ratios were recorded (Table 3), which suggests room for further improvements in the diagnosis and/or treatment of these diseases. The association of general practitioners in Curaçao recommends an annual seasonal flu vaccination for every person at risk, but only 6% of the target population had received one during the 2016 season (8). Moreover, the procedures necessary to quickly detect and respond to infectious disease outbreaks are non-existent in Curaçao (22), and childhood immunization coverage is below 95% (Table 3). This is especially concerning in light of the resurgence of vector-borne and vaccine-preventable outbreaks in Venezuela, the neighboring country (23, 24). It is unclear whether the high coverage recorded in Aruba indeed reflects higher population immunization rates, as the reported estimates preceding the introduction of the child monitoring system from Curaçao also consistently depicted an overly optimistic coverage of >95%.

Perinatal deaths stem from health care related causes such as the inappropriate management of complications during pregnancy and delivery. During the study period, perinatal mortality was consistently higher in NA/Curaçao than in Aruba and the Netherlands. Curaçao also recorded a maternal mortality ratio that was three times higher than in Aruba (Table 3). This suggests that the effectiveness of mother-and-child care is unsatisfactory in Curaçao. An important reason for Curaçao's poorer outcomes could be the fragmented organization of perinatal care services, with midwives providing services in the maternity clinic, and gynecologists in private practices and the main hospital located several kilometers away. In Aruba, in contrast, midwives and gynecologists work closely together in the main hospital. Further investigation should determine whether the low perinatal mortality in Aruba reflects lower incidences of underlying risk factors, better care during the antenatal period and during delivery, and/or a registration artefact, for example, from the exclusion of stillbirths.

All in all, the information on health care in the Dutch Caribbean suggests that the excess amenable mortality from circulatory diseases, breast cancer, perinatal deaths, and nephritis/nephrosis in the Dutch Caribbean, at least partly, reflects

differences in the effectiveness of health care services between the Dutch Caribbean and the Netherlands. As we mentioned earlier, this study is an initial step to identify health care areas whose optimization could improve population health in the Dutch Caribbean islands of Aruba and Curaçao. This enables the local governments to prioritize health care areas where improvements are possible and necessary, but does not allow to specify which improvements in health care processes will most likely lead to improved population health outcomes. Therefore, more in-depth studies investigating care delivery related to these amenable causes of death are necessary to identify the interventions and resources needed for health care strengthening in the Dutch Caribbean. One specific recommendation is to evaluate the access and quality of noncommunicable disease services delivered at primary and secondary health care facilities, with the objective to scale up the prevention, detection, treatment, and follow-up of hypertension and diabetes. Similarly, a quality-of-care audit can identify suboptimal processes in mother-and-child services: implementation of recommendations from quality-of-care audits have been shown to reduce perinatal deaths by up to 30% (25).

In further investigations, the small scale of the Dutch Caribbean islands should be taken into account. The volume of certain complex specialist interventions, for example, may be too low to guarantee quality of care, which increases the risks of mortality from the underlying conditions. To illustrate, surgeons in the Netherlands commonly offer services in a specific area of specialization, while most surgeons in Aruba and Curaçao offer general services. Also, medical treatment abroad may be necessary because not all medical specializations are available on the islands, which is likely to increase the waiting time to start treatment for certain procedures. Nevertheless, every health care system, big or small, needs to be optimized to provide the best care that the available resources can buy.

Our study has several limitations. First, the analyses are constrained by the limited availability of mortality statistics, by the uncertain accuracy and consistency of cause-of-death certification and coding, and by the relatively small populations of the Dutch Caribbean. Preferably, mortality data would have been available for the complete study period in all territories of the Kingdom of the Netherlands, but this was not the case and is an important fact in itself, illustrating severe shortcomings in health monitoring systems. Data of Aruba and NA/Curaçao also had more inadequacies and were more incomplete than data from the Netherlands (Table 4). Registered deaths were corrected for data inadequacies and incompleteness using PAHO methods, so the effects of data quality were minimized as much as possible (14). Due to their small populations, the year-to-year fluctuations in mortality rates are relatively large in the Dutch Caribbean. This made it impossible to run Joinpoint analyses for determining trend breaks in the mortality series for the Dutch Caribbean.

Another limitation is that cross-country variation in amenable mortality does not automatically imply that differences in health care performance are involved (26). Other factors that are not related to health care performance, such as disease incidence, may also play a role in generating higher mortality in the Dutch Caribbean. Disease incidence is also influenced by factors outside of the health care system, such as socioeconomic conditions, health behaviors, and environmental factors. Many of these factors are less favorable in the Dutch Caribbean. For example, income distributions are far more unequal than in the

**TABLE 4. Overview results of quality assessment of death registration data for Aruba, the Netherlands Antilles/Curaçao, and the Netherlands, ages 0–74 years, by data year. Empty cells indicate mortality data were not available for that particular calendar year.**

Data years available	Netherlands			Aruba			Netherlands Antilles			Curaçao		
	No. of deaths	Ill-defined conditions (%)	Completeness (%)	No. of deaths	Ill-defined conditions (%)	Completeness (%)	Number of deaths	Ill-defined conditions (%)	Completeness (%)	No. of deaths	Ill-defined conditions (%)	Completeness (%)
1988	54 692	4.2	100				559	4.8	85.8			
1989	55 467	4.8	100				531	8.3	84.1			
1990	55 130	4.9	100				508	7.3	79.8			
1991	55 333	4.4	100				492	4.7	75.2			
1992	55 146	4.4	100				558	5.7	84.5			
1993	57 135	4.3	100				592	3.0	85.5			
1994	55 947	4.1	100				575	4.0	81.1			
1995	55 999	4.5	100				631	7.3	86.1			
1996	56 354	4.5	100				588	3.2	83.0			
1997	54 832	4.5	100				510	1.6	70.7			
1998	54 881	4.9	100				585	3.9	82.6			
1999	55 261	5.2	100	336	6.5	81.1	596	4.0	83.0	446	6.7	77.1
2000	54 725	5.3	100	299	3.7	74.6	545	3.1	72.0			
2001	54 324	5.8	100	276	5.4	67.2						
2002	54 419	5.5	100	295	4.1	73.2				582	2.6	100
2003	53 649	5.0	100	296	3.4	71.4				605	3.1	99.9
2004	51 933	4.6	100	301	2.0	70.8				656	3.8	100
2005	50 478	4.2	100	283	6.4	67.3				487	2.9	83.2
2006	49 262	4.3	100	305	6.2	71.2				598	3.0	98.7
2007	48 228	4.1	100	321	5.9	70.4				607	3.1	99.9
2008	48 321	4.1	100	337	8.6	72.7						
2009	48 168	4.1	100	342	4.4	77.0						
2010	48 347	4.0	100	346	2.9	77.0						
2011	47 944	3.8	100	330	3.0	75.7						
2012	48 934	3.9	100	329	5.8	71.9						
2013	48 851	4.4	100	303	1.7	65.6						
2014	48 079	4.3	100	316	1.9	71.7						

Source: Author's own calculations.

Netherlands (27) and obesity is twice as prevalent in Curaçao than in the Netherlands (28). Also, sulfur dioxide emissions recorded in Curaçao are among the highest in the world (29). Observed differences in amenable mortality in cross-country comparisons, however, cannot be solely attributed to differences in disease incidence. In two recent studies, amenable mortality rates were controlled for incidence of underlying conditions, yet substantial cross-country variations remained (30, 31). An argument supporting the view that health care performance is involved in the mortality differences between the Dutch Caribbean and the Netherlands is our finding that amenable mortality has generally decreased faster than non-amenable mortality during the study period (Table 1). This suggests that improvements in health care were at least partly responsible for the mortality decline in amenable causes (32). Moreover, the identified amenable causes of death with the largest contribution to life expectancy differences with the Netherlands were supported by other information on the health care system, from which we conclude that, indeed, the variation in amenable mortality rates reflect differences in the effectiveness of health care services between Aruba, Curaçao, and the Netherlands.

## Conclusions

Improvements in health care services related to circulatory diseases, breast cancer, perinatal deaths, and nephritis/nephrosis in the Dutch Caribbean could substantially contribute to reducing the gap in life expectancy with the Netherlands. Based on our study, we recommend more in-depth studies to identify the specific interventions and resources needed to optimize the underlying health care areas.

**Author contributions.** SV conceived the original idea, planned the experiments, collected and analyzed the data. All authors interpreted the results. SV wrote the paper. HvO and JM critically revised the paper. All authors reviewed and approved the final version.

**Conflicts of interest.** None declared.

**Disclaimer.** Authors hold sole responsibility for the views expressed in the manuscript, which may not necessarily reflect the opinion or policy of the *RPSP/PAJPH* and/or PAHO.

## REFERENCES

1. United Nations Department of Social and Economic Affairs. World Population Prospects: The 2017 Revision [Internet]. 2017 [cited 2019 Apr 8]. Available from: <http://esa.un.org/wpp/index.htm>
2. Verstraeten SPA, van Oers HAM, Mackenbach JP. Differences in life expectancy between four Western countries and their Caribbean dependencies, 1980-2014. *Eur J Public Health*. 2019;30(1):85–92.
3. Snoeijs S, Boerma W. Evaluatie van de structuur van en de zorgverlening in de eerstelijnsgezondheidszorg op Curaçao. Utrecht: NIVEL; 2012.
4. Smits JPJM, Droomers M, Westert GP. Sociaal-economische status en toegankelijkheid van zorg in Nederland. RIVM rapport 279601002/2002. Bilthoven: Rijksinstituut voor de Volksgezondheid en Milieu (RIVM); 2002.
5. Alberts JF, Sanderman R, Eimers JM, Van Den Heuvel WJA. Socio-economic inequity in health care: A study of services utilization in Curaçao. *Soc Sci Med*. 1997;45(2):213–20.
6. Bodok S, Kwidama E, Lourens N, Schroen M, Wijk van N, Kwidama L, et al. Wachten op specialistische zorg op Curaçao: betekent PP “Poko Poko”? IV. Willemstad, Curaçao: Eilandgebied Curaçao; 2008.
7. Verstraeten S. Resultaten monitor wachttijden medisch specialistische zorg. Willemstad, Curaçao: Volksgezondheid Instituut Curaçao; 2017.
8. Verstraeten S, Griffith M, Pin R. De Nationale Gezondheidsenquête 2017. Willemstad, Curaçao: Volksgezondheid Instituut Curaçao; 2018.
9. Central Bureau of Statistics. Statline [Internet]. [cited 2016 Nov 29]. Available from: <http://statline.cbs.nl/Statweb/?LA=nl>
10. Verstraeten SPA, Jansen I, Pin R, Brouwer W. De Nationale Gezondheidsenquête 2013: methodologie en belangrijkste resultaten. Willemstad, Curaçao: Volksgezondheid Instituut Curaçao; 2013.
11. Karsen B, Hurkens K, Jurling B. Resultaten van het onderzoek norminkomen apothekers. Willemstad; 2011.
12. World Health Organization. WHO mortality database, April 2018 update [Internet]. [cited 2018 Oct 1]. Available from: [http://www.who.int/healthinfo/mortality\\_data/en/](http://www.who.int/healthinfo/mortality_data/en/)
13. Nolte E, McKee M. Does health care save lives? Avoidable mortality revisited. London: The Nuffield Trust; 2004.
14. Silvi J. On the estimation of mortality rates for countries of the Americas. *Epidemiol Bull Pan Am Heal Organ*. 2003;24(4):1–5.
15. Ahmad OB, Boschi-Pinto C, Lopez AD, Murray CJL, Lozano R, Inoue M. Age Standardization of Rates: A New WHO Standard. Geneva; 2001. (GPE Discussion Paper Series).
16. Auger N, Feuillet P, Martel S, Lo E, Barry AD, Harper S. Mortality inequality in populations with equal life expectancy: Arriaga's decomposition method in SAS, Stata, and Excel. *Ann Epidemiol*. 2014;24(8):575–80.
17. Plug I, Hoffmann R, Mackenbach JP, editors. Avoidable mortality in the European Union. Volume 1: Final report. Public Health. Rotterdam: EU Public Health Program 2007106; 2011.
18. Autier P, Boniol M, Koechlin A, Pizot C, Boniol M. Effectiveness of and overdiagnosis from mammography screening in the Netherlands: population based study. *BMJ*. 2017;359(j5224).
19. Agyemang C, Kieft S, Snijder MB, Beune EJ, Van Den Born BJ, Brewster LM, et al. Hypertension control in a large multi-ethnic cohort in Amsterdam, The Netherlands: The HELIUS study. *Int J Cardiol*. 2015;183:180–9.
20. Snijder MB, Agyemang C, Peters RJ, Stronks K, Ujic-Voortman JK, van Valkengoed IGM. Case Finding and Medical Treatment of Type 2 Diabetes among Different Ethnic Minority Groups: The HELIUS Study. *J Diabetes Res*. 2017;2017:1–8.
21. Coenen T. Making a difference through health. How PwC is Helping to Change Lives. Impact case studies. Oranjestad, Aruba: PricewaterhouseCoopers; 2016.
22. Algemene Rekenkamer Curaçao. Chikungunya, aanpak van de bestrijding. Willemstad: Algemene Rekenkamer Curaçao; 2016.
23. Paniz-Mondolfi AE, Tami A, Grillet ME, Márquez M, Hernández-Villena J, Escalona-Rodríguez MA, et al. Resurgence of vaccine-preventable diseases in Venezuela as a regional public health threat in the Americas. *Emerg Infect Dis*. 2019;25(4):625–32.
24. Grillet ME, Hernández-Villena J V, Llewellyn MS, Paniz-Mondolfi AE, Tami A, Vincenti-Gonzalez MF, et al. Venezuela's humanitarian crisis, resurgence of vector-borne diseases, and implications for spillover in the region. *Lancet Infect Dis*. 2019;3099(18):1–13.
25. Pattinson R, Kerber K, Waiswa P, Day LT, Mussell F, Asiruddin S, et al. Perinatal mortality audit: Counting, accountability, and overcoming challenges in scaling up in low- and middle-income countries. *Int J Gynecol Obstet*. 2009;107(suppl):S113–21.
26. Mackenbach JP, Hoffmann R, Khoshaba B, Plug I, Rey G, Westering R, et al. Using “amenable mortality” as indicator of healthcare



- effectiveness in international comparisons: results of a validation study. *J Epidemiol Community Health*. 2013;67(2):139–46.
27. Centraal Bureau voor de Statistiek. Publicatiereeks Censur 2011. Vierbergen F, editor. Inkomens en inkomensverdelingen. Willemstad; 2011.
  28. Verstraeten S, Griffith M, Pin R. De nationale gezondheidsenquête Curaçao 2017. Willemstad: Volksgezondheid Instituut Curaçao; 2018.
  29. Pulster EL, Johnson G, Hollander D, McCluskey J, Harbison R. Exposure Assessment of Ambient Sulfur Dioxide Downwind of an Oil Refinery in Curaçao. *J Environ Prot (Irvine, Calif)*. 2018;9(3):194–210.
  30. Kruk ME, Gage AD, Joseph NT, Danaei G, García-Saisó S, Salomon JA. Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. *Lancet*. 2018;392(10160):2203–12.
  31. Alkire BC, Peters AW, Shrimme MG, Meara JG. The economic consequences of mortality amenable to high-quality health care in low- and middle-income countries. *Health Aff*. 2018;37(6):988–96.
  32. Mackenbach J, Bouvier-Colle M, Jouglu E. “Avoidable” mortality and health services: a review of aggregate data studies. *J Epidemiol Community Health*. 1990;44(2):106–11.

Manuscript received on 26 October 2019. Revised version accepted for publication on 24 February 2020.

## Contribución de la mortalidad por causas evitables mediante la atención de salud a la diferencia de la esperanza de vida entre las islas del Caribe holandés de Aruba y Curaçao y los Países Bajos

### RESUMEN

**Objetivo.** Determinar las áreas específicas de atención de salud cuya optimización podría mejorar la salud de la población en las islas del Caribe holandés de Aruba y Curaçao.

**Métodos.** Estudio de observación comparativo en el que se utilizaron datos demográficos y de mortalidad de las islas del Caribe holandés y de los Países Bajos. Se calcularon las tendencias de mortalidad y luego se analizaron con programas de computación Jointpoint de regresión lineal segmentada, para el período 1988–2014. La esperanza de vida se calculó utilizando tablas de mortalidad abreviadas con los datos más recientes disponibles de todos los territorios (2005–2007). Las diferencias de esperanza de vida entre el Caribe holandés y los Países Bajos se desglosaron, usando el método de Arriaga, en contribuciones por causas específicas.

**Resultados.** En el período 1988–2014, los niveles de mortalidad por causas evitables mediante la atención de salud han sido sistemáticamente mayores en Aruba y Curaçao que en los Países Bajos. En el caso de Aruba, la brecha en la mortalidad por causas evitables mediante la atención de salud con respecto a los Países Bajos no varió significativamente durante el período de estudio; en el caso de Curaçao, la brecha fue mayor. Si la mortalidad por causas evitables mediante la atención de salud se redujese a un nivel similar al de los Países Bajos, los hombres y las mujeres en Aruba habrían sumado, respectivamente, 1,19 años y 0,72 años a su esperanza de vida en el período 2005–2007. En Curaçao, el aumento hubiese sido de 2,06 años y de 2,33 años. Según el estudio, las causas específicas que más contribuyen a esta diferencia son las enfermedades circulatorias, el cáncer de mama, las complicaciones perinatales, y la nefritis/nefrosis (estas últimas dos causas solamente en Curaçao).

**Conclusiones.** Una mejora en los servicios de salud en relación con las enfermedades circulatorias, el cáncer de mama, las complicaciones perinatales, y la nefritis/nefrosis en el Caribe holandés podría contribuir sustancialmente a la reducción de la brecha en la esperanza de vida con respecto a los Países Bajos. Por tanto, con base en nuestro estudio, recomendamos que se realicen más estudios exhaustivos a fin de determinar las intervenciones específicas y los recursos que se necesitan para optimizar las áreas de atención de salud involucradas.

### Palabras clave

Evaluación en salud; indicadores de calidad de la atención de salud; Aruba; Curazao; Países Bajos.

---

## Contribuição da mortalidade evitável para as diferenças na expectativa de vida entre as ilhas de Aruba e Curaçao, no Caribe holandês, e os Países Baixos

### RESUMO

**Objetivo.** Identificar áreas específicas da atenção à saúde cuja otimização poderia melhorar a saúde da população nas ilhas de Aruba e Curaçao, no Caribe holandês.

**Métodos.** Estudo observacional comparativo baseado em dados de mortalidade e populacionais das ilhas do Caribe holandês e dos Países Baixos. As tendências de mortalidade foram calculadas e então analisadas com o software Joinpoint, no período de 1988 a 2014. As expectativas de vida foram computadas usando tábuas de mortalidade resumidas com os dados disponíveis mais recentes de todos os territórios (2005-2007). As diferenças na expectativa de vida entre o Caribe holandês e os Países Baixos foram desagregadas segundo as contribuições específicas por causa usando o método de Arriaga.

**Resultados.** No período de 1988 a 2014, os níveis de mortalidade evitável foram consistentemente mais elevados em Aruba e Curaçao do que nos Países Baixos. Em Aruba, a diferença na mortalidade evitável em comparação com os Países Baixos não mudou significativamente durante o período do estudo, enquanto que em Curaçao a diferença aumentou. Se a mortalidade por causas evitáveis fosse reduzida a níveis semelhantes aos dos Países Baixos, os homens e mulheres de Aruba teriam aumentos respectivos de 1,19 e 0,72 anos nas suas expectativas de vida durante o período 2005-2007. Em Curaçao, o aumento seria de 2,06 e 2,33 anos. As maiores contribuições de causas específicas foram as de doenças circulatórias, câncer de mama, causas perinatais e nefrite/nefrose (estas duas últimas causas somente em Curaçao).

**Conclusões.** Melhorias nos serviços de saúde relacionados com doenças circulatórias, câncer de mama, mortes perinatais e nefrite/nefrose no Caribe holandês poderiam contribuir substancialmente para reduzir as disparidades na expectativa de vida em comparação com os Países Baixos. Com base neste trabalho, recomendamos estudos mais aprofundados para identificar as intervenções e recursos específicos necessários para otimizar estas áreas da atenção à saúde.

**Palavras-chave** Avaliação em saúde; indicadores de qualidade em assistência à saúde; Aruba; Curaçao; Países Baixos.

---