Demographic developments in Curaçao: focus on fertility

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Introduction

During the fourth quarter of 2016 the population of Curaçao reached a size of 160,000 inhabitants. In the fifteen years leading up to 2017 a total of 33,000 persons were added to the population, which translates to a total growth of 26 percent, or an average annual growth rate[1] of 1.5 percent. While migration has been the main driver of population growth in recent decades, natural population growth, the difference between the number of births and the number of deaths over a given period, has always been a steady contributor to population growth. Because fertility and mortality developments usually happen very gradually the outcome of these processes, the annual number of births and number of deaths, do not fluctuate very much, as opposed to the number of migrants. However, in the three years up to 2016 a rather sharp decline in the number of births and a steep increase in the number of deaths have been registered in Curaçao, both developments more intense than expected. This article aims to examine the recent trends in population growth and focus especially on the sharp decline in fertility and the characteristics of this decline. In a future article the increased number of deaths and its possible causes shall be addressed. Furthermore determinants of fertility decline, in general and for Curaçao specific, will be discussed. One of the potential factors of fertility decline that will be considered in this article is the outbreak of two vector-borne disease epidemics shortly after one another in the 2014-2016 period, namely the 2014/2015 chikungunya epidemic and the 2016 Zika epidemic.

The data used for this article are live birth, death and migration registrations from the population registry of Curaçao, in combination with population census data.

Population size reaches 160,000 despite declining growth

The recent growth pattern of the population of Curaçao remained positive in 2016. A net number of almost 1,350 persons were added to the population. Compared to the previous three years however, this means a decline in absolute growth of close to 700 persons per year (table 1 and figure 1). Both the natural growth and net migration declined in 2016.

A drop in immigration accounted for the decline in net migration in 2016. While the number of persons leaving the island to settle somewhere else remained the same as in 2015 the number of immigrants moving to Curaçao decreased by 500 persons.

A decreasing number of live births in the years 2015 and 2016 and an increasing number of deaths over the last three years saw the natural growth decline from 700 persons in 2013 to 300 persons in 2016. Especially the smaller number of children born in the past two years seems a remarkable development in spite of population growth. At the same time the increasing number of deaths is notable, but may seem more comprehensible given the current situation of population ageing in Curaçao: the higher the number of elderly in the population, the more deaths can be expected.

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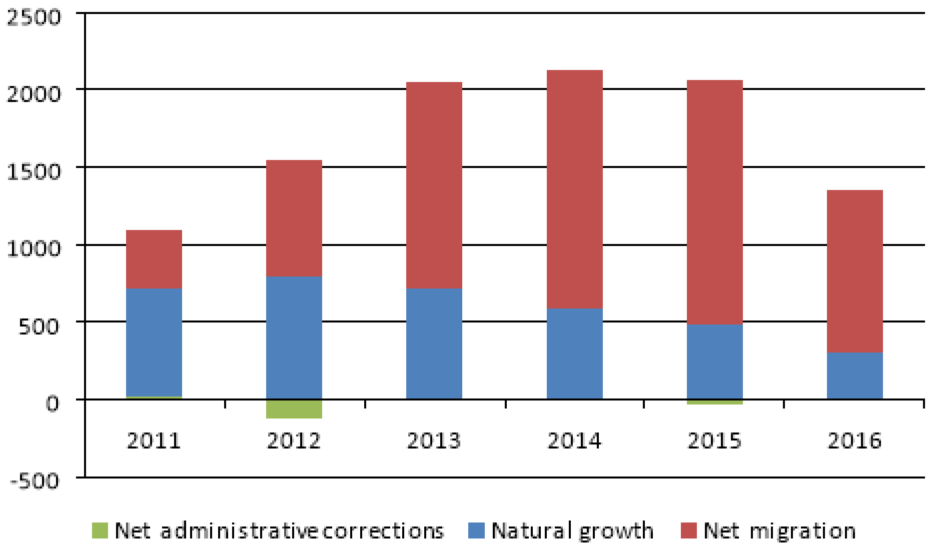
[1] Average exponential rate of growth of the population over a given period. It is calculated as ln(Pt/P0)/t where t is the length of the period. It is expressed as a percentage.

Table 1. Vital statistics Curaçao, 2011-2016

	2011	2012	2013	2014	2015	2016	2017
Population size (Jan. 1st)[2] (P_t)	150284	151378	152798	154846	156971	158989	160337
Live births (B)	1974	2039	1962	1963	1877	1789	
Deaths (D)	1276	1246	1250	1370	1398	1482	
Natural growth (B-D)	*698*	*793*	*712*	*593*	*479*	*307*	
Immigration (I)	5276	4878	5392	5676	5959	5451	
Emigration (E)	4900	4121	4056	4137	4381	4404	
Net migration (I-E)	*376*	*757*	*1336*	*1539*	*1578*	*1047*	
Net administrative corrections[3] (AC)	20	-130	0	-7	-39	-6	
Total growth (= B – D + I - E + AC)	*1094*	*1420*	*2048*	*2125*	*2018*	*1348*	

Figure 1. Natural growth, net migration and net administrative corrections Curaçao, 2011-2016



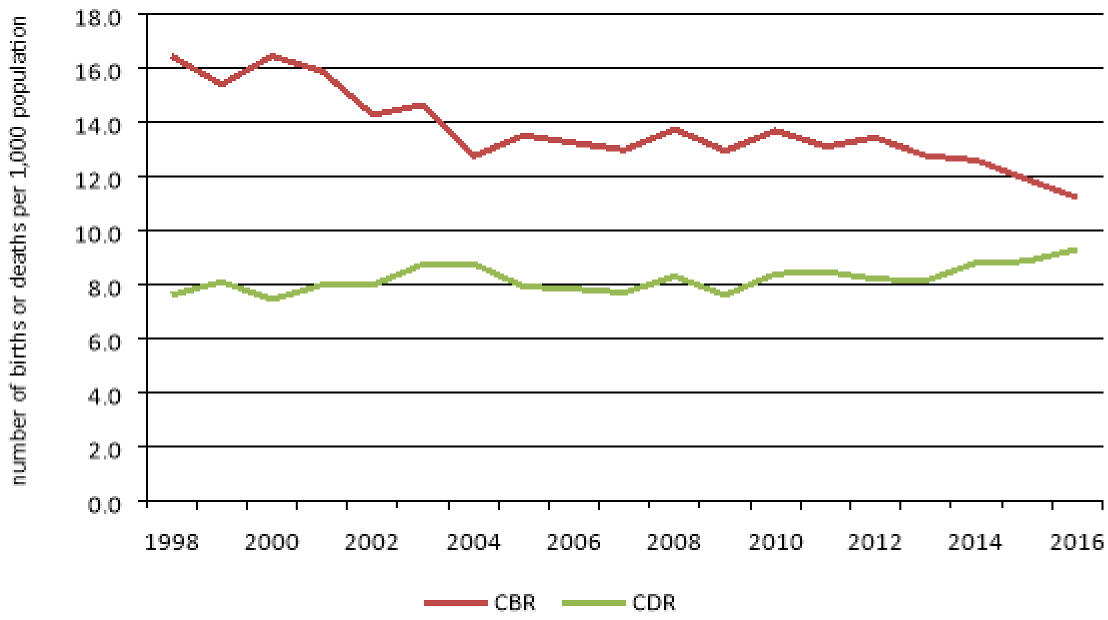
Crude birth rate and crude death rate

The number of births and number of deaths expressed as a ratio of the total population, the crude birth rate (CBR) and the crude death rate (CDR), give a good indication of the general trends in fertility and mortality in the population. Figure 2 shows the development of the CBR and the CDR over the period 1998-2016. Over this 19 year period the CBR and the CDR have increasingly moved towards each other. The CBR has decreased from approximately 16 births per 1,000 persons in the population to about 13 births per 1,000 persons between 1998 and 2004, and remained relatively stable from 2004 to 2012 before decreasing further to 11.2 births per 1,000 persons in 2016. The CDR has virtually hovered around 8 deaths per 1,000 persons per year from 1998 to 2013 before starting to increase to 9.3 deaths per 1,000 persons in 2016. The graph shows how the CBR and the CDR have moved in opposite directions at an accelerated pace between 2013 and 2016 as compared to the previous ten years.

[2] The balancing equation of population growth: $P_{t+1} = P_t + B – D + I - E (+ AC)$

[3] Administrative inclusion in or exclusion from the population register for reasons other than birth, death or migration. Usually corrections relate to persons who failed to register their immigration or emigration.

Figure 2. Crude Birth Rate and Crude Death Rate Curaçao, 1998-2016



Determinants of fertility decline

In 2015 and 2016 remarkable less live births were registered in Curaçao than in the years prior to that. In a period of two years the number of live births decreased by nine percent. Even though it is expected that the fertility rate in Curaçao will decrease in the future, as will be explained in the next part, the current drop in live births is sudden and exceptionally large: from 1,963 children in 2014 to 1,789 children in 2016. This is visible in the total fertility rate[4] (TFR) as well, which declined from 2.04 children per woman in 2014 to 1.74 children in 2016.

To interpret these fertility statistics some background information and moreover a theoretical framework are needed. Empirical evidence in demographic research has established the well-known demographical theory of *demographic transition* (Livi-Bacci, 1997). This population transition model describes a transition, in several phases, from high to low levels of mortality as well as fertility, and the outcome of these developments on population growth. Part of this transition, which can span multiple decades, is a decline in TFR levels as high as 5 or more children per woman to levels (far) below the *replacement level*[5] of 2.1 children per woman. Many causes of fertility decline in populations worldwide have been identified over decades in demographic research. Sánchez-Barricarte (2017) states that '*fertility behavior takes place in a multilevel setting of biological, psychological, social, economic, cultural, and political conditions, the level of fertility observed in a country over time is the result of a complex interaction between many factors from different areas of life*'. Some of the important causes for fertility decline that have been identified are:

- *mortality decline*: in the past when child mortality was much higher than nowadays parents produced more children to ensure reproduction at higher level of child mortality
- *economic development*: with the increase in economical welfare the necessity to have more children (as financial security and caretakers at old age) declined

[4] The total fertility rate (TFR) indicates the average number of children a woman would bear if she survived through the end of the reproductive age span and experienced at each age a particular set of age-specific fertility rates.
[5] A TFR of 2.1 is considered replacement level fertility. At this level of fertility the female population 'reproduces' itself, meaning that the female population exactly replaces itself (under condition of continuation of current fertility and mortality rates) providing for sustenance of current population levels.

- *education level*: can affect preferences for fertility timing (when to have children), raise female autonomy, and increase contraceptive use for example
- *the emergence of the welfare state*: the implementation of social security systems (e.g. healthcare, unemployment benefits, old age pensions) led to a reduced need for children to provide for economical and social security at old age (Sánchez-Barricarte, 2017)

In Curaçao surely some, or perhaps all, of the fore mentioned causes of fertility decline will have played a role in its historical fertility decline. Curaçaos' TFR dropped from a level of around 5 children per woman in the 1950s to a level close to 2.1 children per woman in the 1980s that has been practically maintained ever since. Many other variables have contributed to the historical, but also more recent, fertility decline in Curaçao. For example, immigration of foreign-born women with different (lower) fertility levels, increased female labour force participation, and family planning initiatives have had an impact on the fertility level (CBS, 2014).

Characteristics of the 2015/2016 fertility decline

In this theoretical and historical context a decline in fertility in Curaçao is not surprising, but the abruptness and the magnitude of the recent decline in 2015 and 2016 raises questions on what caused such a decline.

The size and age composition of the female population

Considering the female population in the reproductive ages, i.e. between 15 and 50 years of age, remained virtually identical in size for the last ten years would suggest that the number of births would remain stable, or change only very gradually because of a shifting age composition in the female population and because of current trends in fertility, as mentioned before. Because fertility rates vary over age (fertility rates are highest for women aged 20-34 years and are lower for women younger than 20 years or 35 years and older) it can be expected that the total number of children born changes gradually when the age composition of the female population shifts. However, the age composition of the female population in the reproductive ages in Curaçao has actually changed in favour of more births in 2015 and 2016: the female population with the highest fertility rates (aged 20-34 years) has increased, while at the same time the female population with the lowest fertility rates has decreased. In other words, if the level of fertility remained unchanged more children would have been expected to be born in 2015 and 2016. Therefore, the decline in live births must be primarily the result of a decline in fertility[6] and not of changes in the female population size and age composition.

Temporal fluctuations in number of births

Then why the sudden drop in fertility? An examination of the distribution of live births over time provides information on temporal fluctuations in the number of births. Table 2 shows the percentage deviation for a given month from the average number of children born in that month. The average is calculated for the years 2011-2016. For example, in April 2013 the number of children born in Curaçao was six percent higher than the average number of children born in April 2011-2016. The colors in table 2 indicate a positive (green) or a negative (red) deviation. The darker the color, the larger the deviation.

[6] The term fertility refers to the process of reproduction by members of a population. This process depends on the individual biological capacity to reproduce (fecundity) and on sexual behaviour (determined by societal standards and values, as well as individual choices towards having children) of the members of the population. The number of births in a given period is the result of this process.

Table 2. Percentage deviation from monthly average number of live births in the period 2011-2016

	2011	2012	2013	2014	2015	2016
January	-8%	0%	-5%	-2%	0%	15%
February	-12%	16%	3%	-9%	4%	-1%
March	5%	-7%	-3%	10%	3%	-8%
April	0%	-3%	6%	-6%	2%	1%
May	1%	7%	12%	-3%	-5%	-11%
June	-10%	3%	-6%	15%	7%	-8%
July	-3%	14%	9%	6%	-7%	-20%
August	3%	9%	-5%	8%	-13%	-1%
September	10%	8%	-5%	7%	-14%	-6%
October	12%	-2%	0%	4%	-2%	-11%
November	12%	2%	25%	-7%	-12%	-19%
December	7%	19%	-14%	-1%	6%	-17%

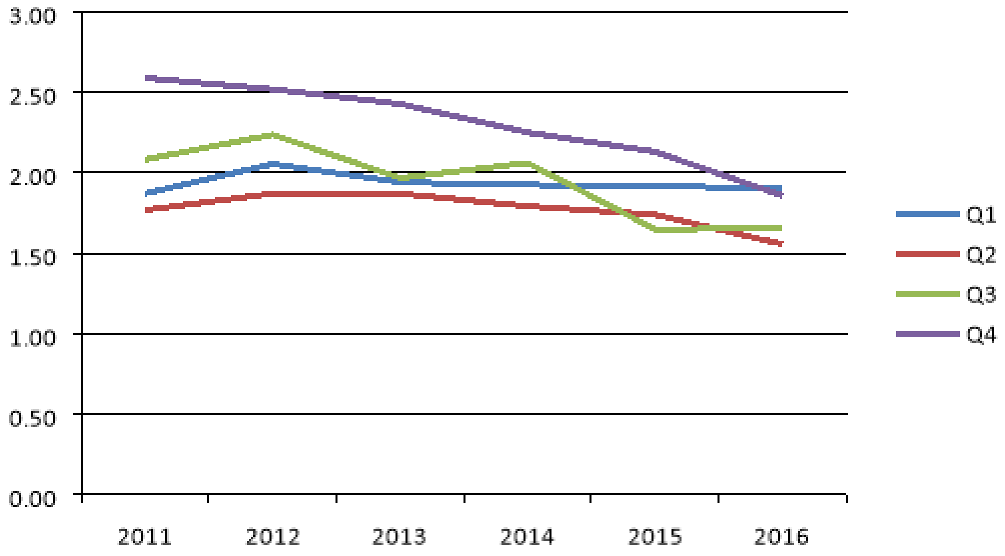
Deviations occur in all years and appear to occur at random in many cases, especially from 2011 to 2014. The causes of these deviations can vary widely and may remain unidentified. Also, in small populations small absolute fluctations can appear as relatively large deviations. But, the image in table 2 shows a quite distinctive pattern in 2016 and, to a lesser extent, in 2015. The deviations in 2015 and 2016 are mostly negavtive, but the clustering of larger negative values in the third and fourth quarter of 2015 and the almost persistent negative values in the second, third and fourth quarters of 2016, stand out from the general picture.

Quarterly fertility levels

The number of births is not the best indicator for measuring a decline in fertility, because it does not take into account the number of women in the reproductive ages and the age composition of this group, which both develop over time and determine the number of births. To control for these variables the total fertility rate (TFR) for each quarter[7] of the years 2011 to 2016 has been calculated and visualized in figure 3. The graph visualizes the changes in fertility by quarter for the given period. In the period of observation in Curaçao the TFR is usually highest in the fourth quarter reaching levels as high as 2.5 children per woman and over, albeit declining over the years. The third quarter is normally characterized as the second most fertile quarter and the second quarter as the least fertile quarter. Clearly the TFR in the third and fourth quarter has dropped considerably in 2015 and 2016: from 2.06 in 2014 to 1.65 children in 2015 and 2016 (Q3) and from 2.25 in 2014 to 1.86 in 2016 (Q4). The TFR in the fourth quarter has even declined continuously between 2011 and 2016, and by a large degree. The TFR in the second quarter has decreased as well in 2015 and 2016, but to a lesser degree.

[7] The currently available data allows for the estimation of quarterly TFR, but not monthly TFR.

Figure 3. Total Fertility Rate by quarter, Curaçao, 2011-2016



Potential causes of fertility decline in 2015 and 2016

The timing of the 2015/2016 fertility decline occurs at periods that appear to coincide with two recent emerging outbreaks in the population of Curaçao: the 2014/2015 chikungunya epidemic and the 2016 Zika epidemic.

Chikungunya epidemic

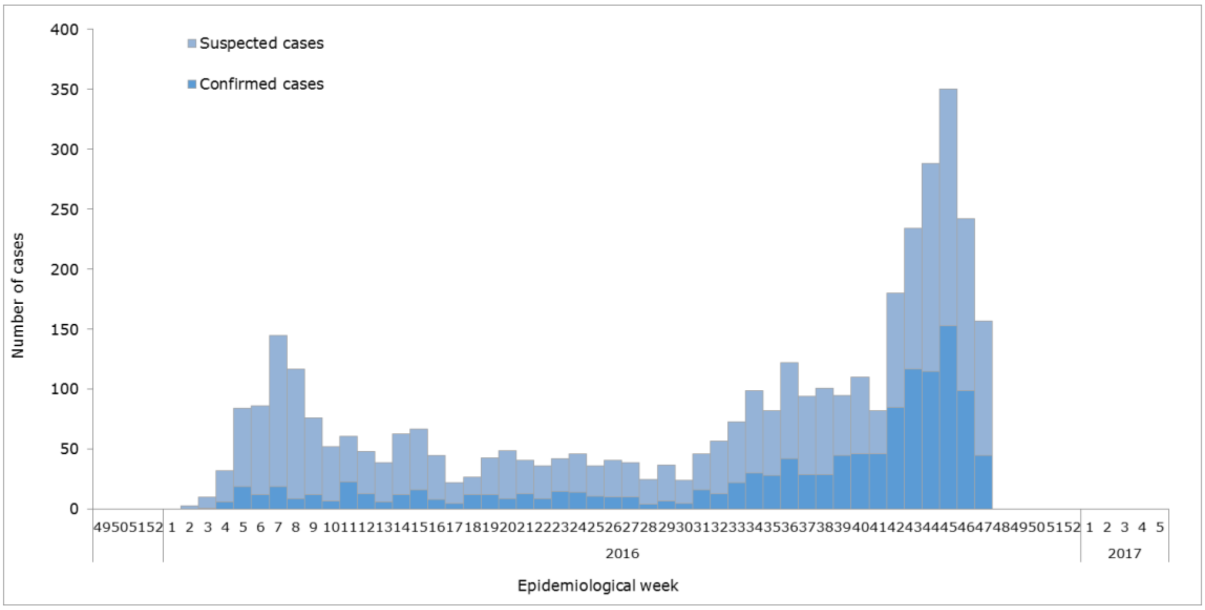
In the fourth quarter of 2014 a major epidemic of chikungunya in Curaçao was registered. The Epidemiology & Research Unit of the Ministry of Public Health, Environment and Nature estimated that at the peak of the epidemic, in November/December 2014, about 20,000 persons (almost 13 percent of the population) were infected with the chikungunya virus (AD, 2014; NOS, 2014). The virus can, among others, cause acute symptoms of high fever, severe joint pains, headache and rash in patients (PAHO, 2017).

The apparent decline in number of births in 2015 starts nine months after the onset of the chikungunya epidemic and lasts five months (see table 2). The number of births bounces back to (above) average levels in December 2015 and January 2016. This period coincides with the end of the chikungunya epidemic about nine months earlier in March 2015 (RIVM, 2016). The decline in births thus coincides in time with the Chikungunya epidemic in Curaçao and raises the question of the possibility of an association between these two developments. Is it possible that a chikungunya infection can affect the decision of getting pregnant? The physical symptoms of the disease may have limited the probabilities of getting pregnant. Perhaps a rational choice was made to delay pregnancy untill after the epidemic by some. Nevertheless, the data merely shows how the decline in fertility follows the chikungunya epidemic in time and place. It does not provide any evidence for a causal relationship between the two.

Zika epidemic

In 2016 two short periods with rather large negative deviations in number of births occur, from May to July and from October to December (see table 2). These occurences partly coincide with another epidemic in Curaçao, the Zika virus epidemic. The Zika virus causes similar symptoms in patients as chikungunya. Moreover, scientific evidence has been found that the disease may be transmittable from mother to child during pregnancy and can possibly result in serious health problems in babies (e.g. microcephaly) (PAHO, 2016). Because this epidemic spread through Latin America and the Caribbean region from October 2015 onwards, news on the possible health risks for babies had already reached the population of Curaçao at the time of the onset of the Zika epidemic on the island. In December 2015 the Pan American Health Organization (PAHO) published a first epidemiological alert on the possible relation between congenital anomalies and the Zika virus. The media in Curaçao reported on the first confirmed case of Zika in Curaçao in January 2016 also mentioning the suspected relationship. Given this information, it is not unlikely the Zika epidemic has caused couples to be cautious about family planning and possibly postpone having children.

Figure 3. Suspected and confirmed Zika virus disease cases by week, Curaçao, 2016



Source: (PAHO/WHO, 2017)

A timeline of suspected and confirmed Zika virus disease cases by week in 2016 in Curaçao is shown in figure 3. The two periods with the larger negative deviations in monthly births in 2016 (table 2) start approximately nine months after the first media reports on Zika in Latin America and the Caribbean and approximately nine months after the first confirmed cases of Zika in Curaçao respectively. However, only the second period of negative deviation starts nine months after the first reports on the possible relationship between Zika and birth defects in newborns in Brazil in november 2015 (PAHO, 2016). During the first period of negative deviation this information was yet unknown. The decline in births in this period therefore does not seem to coincide well with the Zika epidemic in Curaçao.

Conclusion and discussion

Natural population growth decreased considerably in 2015 and 2016 because of an increase in the number of deaths and a sharp decrease in number of live births. The decline in number of births was caused by declining fertility levels, mainly in the third and fourth quarters of 2015 and 2016, and not by changes in the size and age composition of the female population. These developments occurred during a period that saw the outbreak of a chikungunya epidemic and a Zika epidemic in Curaçao. Assuming the symptoms of both chikungunya and Zika, and moreover the potential health risks of Zika for pregnant women and babies, may be a crucial factor in deciding to have children, it is not unlikely that women or couples decided to postpone having children because of these epidemics. The decline in fertility as registered in 2015 and 2016 in Curaçao partly coincides with the course and timing of these epidemics, and suggests a possible association. The fertility decline in 2015 coincides well with the timing of the chikungunya epidemic, but the fertility decline in 2016 only partly coincides with the timing of the Zika epidemic in Curaçao. However, the Zika epidemic can be considered more likely to have affected fertility behaviour of couples because of the potential health risks for babies.

Even though the results presented in this article suggest a possible association between both epidemics and the decline in fertility the results are by no means evidence for this hypothesis. Unidentified causes for a decline in fertility cannot be ruled out. In any case, a gradual decline in fertility is expected over time, but not as sharp as has been observed in 2015/2016. Whether the sharp decline in number of births was dependent on the chikungunya and Zika epidemics is subject to further research. Furthermore, future fertility trends should indicate the plausibility of the suggested relationship.

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