2012

Fertility Monograph

Federated States of Micronesia

Acknowledgment

Preface

It gives me a great pleasure to present to you this monograph on fertility. This is one in a series of reports on specific topics identified as having special interest and importance to the Federated States of Micronesia (FSM). This fertility report draws from the findings of the 2010 Census of Population and Housing and available administrative statistics.

This report provides you with an in-depth analysis on fertility in the FSM and attempts to provide some insights on the level of growth in the FSM population (past and future growth), which is influenced by fertility amongst the other contributing factors.

The growth rate of a population is determined by the interplay of fertility, mortality and international migration. Fertility rates are directly related to the population growth and the age structure of the population. Understanding fertility is important for assessing opportunities for boosting economic development as well as for anticipating future challenges, including population ageing.

Policy-makers and planners depend on fertility statistics for effective social planning and allocation of resources to public services, including education and healthcare. A civil registration system is the most efficient data source for the generation of fertility statistics; however, as FSM has not achieved full recording of births, the census provides a unique opportunity to examine the fertility levels and trends of the entire population.

I encourage that you take time to analyse the findings of the report and gain a better understanding on what fertility is and its importance to growth of the FSM population.

The FSM Government is indebted to the United Nations Population Fund (UNFPA) for the funding assistance and guidance and to the author, Mr. Adreas Demkke, for the production of this report. I also acknowledge the support and valuable advice provided by Mr. Michael Levin.

Lastly, I wish to recognize all other individuals, departments, agencies and the staffs of the Statistics Division, Office of Statistics, Budget & Economic Management, Overseas Development Assistance and Compact Management for their good efforts in facilitating the production of the report.
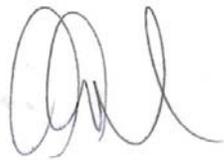
Evelyn Adolph
Director
Office of SBOC

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INDICATOR	FSM	YAP	CHUUK	POHNPEI	KOSRAE
Age group of women	Age-Specific Fertility Rate (ASFR) (number of births per 1000 women, 2008-2010)				
15-19	46	49	48	43	46
20-24	136	143	126	142	161
25-29	177	164	176	172	236
30-34	155	112	171	148	169
35-39	115	89	132	101	134
40-44	58	36	76	45	45
45-49	23	11	31	18	21
Total Fertility Rate (TFR)	3.5	3.0	3.8	3.3	4.1
Estimated number of births (2010)	2,606	251	1,278	902	175
Crude Birth Rate, CBR (2010)	25.3	22.1	26.3	24.9	26.4
Child-woman ratio (CWR)	471	401	501	446	521
General fertility rate	102	87	107	98	114
Mean Age at Childbearing (MAC)	30.5	29.2	31.2	30.0	30.0
Female average age at marriage (SMAM)	25.5	26.0	25.8	25.0	25.7
Females married at age 15-19 (%)	8	9	9	8	4
Females married at age 20-24 (%)	37	35	36	39	37
Females with primary education (%)	54	46	58	54	43
Females with secondary education (%)	32	36	33	29	37
Females with tertiary education (%)	13	15	9	17	18
Proportion of females employed (%)	40	63	32	44	32

Summary of Findings

Fertility levels decreasing steadily

The Total Fertility Rate (TFR), the **average number of children per woman**, declined from 7.8 in 1974 to 5.5 in 1990, 4.4 in 2000 and **3.5** in 2010. The fertility transition started in the early 1970s and showed a relatively steep and continuous decrease until today.

Yap was, with a TFR of 3.0, the State with the lowest level of fertility in the FSM, followed by Pohnpei (3.3.), Chuuk (3.8), and Kosrae with 4.1.

Natural growth remains high

The natural growth rate remains high with 2.2%, and the FSM population will increase by 2,300 people per year if there is no migration. Without migration the size of the population would double in only 32 years.

More than one in five women aged 45-49 years of age had 7 children or more, and 5% had 10 children or more.

Childlessness relatively high

On the other hand, about 15% of all women remained childless at the end of their reproductive years (aged 45-59 years). The incidence of **childlessness** was with 19% especially high in Chuuk. Unfortunately, census data cannot determine whether this was voluntary or involuntary childlessness.

Childbearing of teenagers a worry

About 6% of women aged 15-19 years had given birth. Overall almost 100 births to women younger than 15 years of age were registered during the period 2000-2010, and another 1,061 births of women aged 15-17 years. This should be a major concern as childbearing at these young ages is subject to an increased health risk to mother and child.

The census data show that only a small proportion of teenage women who gave birth attended school. This has grave consequences for these women's future socio-economic prospects.

Educational level and employment status of women strongly impact on the number of children they have

Women's **education level** had a substantial impact on the level of fertility: the higher the level of education, the lower the level of fertility.

Women engaged in **paid employment** had noticeably fewer children than women who did subsistence work or were not in the labor force.

On the other hand, the census data showed that there was no significant correlation between women's **religious affiliation** and their level of fertility. There furthermore was no noticeable difference in fertility levels by **urban-rural residence** of women.

Use of contraception increasing

The **contraceptive prevalence rate** continuously increased during the period 2007-2011 and could explain the recent decrease in birth rates.

Completeness of birth registration improving but needs strengthening

During the period 2001-2009 the **registration of births** has been estimated to be about 82% complete, and it shows an improving trend.

In view of the wealth of information that is potentially available from the FSM **vital statistics system**, it urgently needs to be consolidated and strengthened, and the available information needs to be systematically extracted and comprehensively disseminated.

1 Introduction

1.1 Report: Purpose and structure

The growth rate of a population is determined by the interplay of fertility, mortality and international migration. Fertility rates are directly related to the population growth and the age structure of the population. Understanding fertility is important for assessing opportunities for boosting economic development as well as for anticipating future challenges, including population ageing. Policy-makers and planners depend on fertility statistics for effective social planning and allocation of resources to public services, including education and healthcare. A civil registration system is the most efficient data source for the generation of fertility statistics; however, as FSM has not achieved full recording of births, the census provides a unique opportunity to examine the fertility levels and trends of the entire population. Additionally, the demographic and household characteristics recorded in the census provide an excellent basis for evaluating fertility levels among different groups/sub-groups within the population, such as population by State, urban-rural residence, marital status, and economic and educational background characteristics.

Census taking in the FSM dates back to 1920 when the Japanese collected the first systematic census data for the areas which became Trust Territory of the Pacific Islands (TTPI), and continued to collect these data in 1925, 1930, and 1935. The TTPI High Commissioner's Office took a TTPI-wide census in 1958. The 1967 Census was the first census conducted during the American trusteeship to enumerate the population as of a specific date (March 26, 1967). In 1973, the TTPI administration collected another census after finding serious deficiencies in the 1970 Decennial Census. The 1980 Census was the second decennial Census. The reliability of the data of the 1980 Census was questioned particularly with regards to the coverage of the population.. As a consequence another census was commissioned under the law enacted by the Congress of Micronesia, and was conducted with the assistance of the South Pacific Commission. This Census however turned into four individual censuses, conducted in each State at different points in time, from 1985 to 1989. These censuses are often referred to as the mid-decade censuses. Although the results of these censuses were very accurate, the fact that they were conducted at different points in time and asked different questions presented a problem in comparing and aggregating the figures to a national count. Hence the 1994 Census was initiated, followed by the 2000 and 2010 censuses.

The present census was conducted in April 2010 and enumerated 102,843 people residing in FSM on the census night. Based on the 2010 census, 11 percent of the population of FSM lived in the State of Yap, 47% in Chuuk, 35 percent in Pohnpei, and 6% in Kosrae.

The 2010 census also revealed that the urban population remained at a relatively low level with only 22.3% living in urban areas such as Colonia in Yap, Weno in Chuuk, Kolonia in Pohnpei, and Lelu in Kosrae. Even then, it may be noted that the concept of "urban" in FSM is relative, and refers to relatively small centers of administration and services.

Figure 1 presents the population size and distribution of the FSM from 1920 through to 2010. The population increased steadily over the years and gained momentum during the period 1935 to 1994. Since then the population growth stalled and during the period 2000-2010 the population decreased by more than 4,000 people.

Figure 1: Population size and distribution by State, FSM: 1920-2010
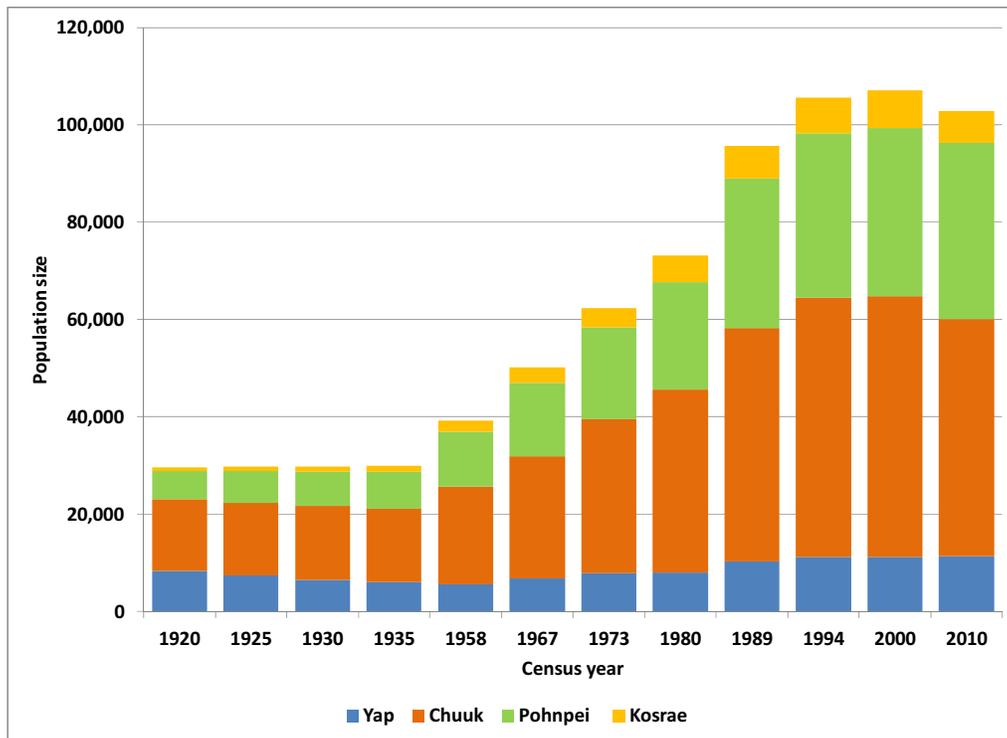
A continuous decline in fertility can play a major role in the reduction of population growth and leads to changes in the age structure of the population. This gives rise to opportunities for boosting development as well as posing future challenges in relation to population ageing. The shift from high birth rates to lower birth rates is in line with the "demographic transition model" which predicts that as a country develops from a pre-industrial to an industrialized economic system both birth and death rates will decline.

A graphic representation of the age structure of the population such as an **age pyramid** shows the different surviving cohorts of people of each sex in the FSM in 2010. A population pyramid shows the number of males and females in single years starting with the youngest age group at the bottom, and increasing with age towards the top of the pyramid. The number of males is depicted to the left and the number of females to the right of the pyramid's center (Figs.2-8).

Note that the number of **females aged 15-49** years is highlighted in light green, as it is these age groups of women who generate the number of births in the population.

The population pyramids have the distinct features of a classical pyramid: it has a wide base, meaning that a large percentage of people are in the younger age groups, with increasingly narrow bars towards the top of the pyramid, representing decreasing age groups at older ages.

The pyramids all have one apparent characteristic in common, which is the deficit of people in prime working ages (20-49) that can be seen in many states, most notably in Kosrae, caused by migration.

The population pyramid of the urban areas presents a very different picture compared to all other pyramids (Fig.3). It shows a high number (a 'bulge') of people aged 15-20 years due to internal migration flows directed towards the urban centers where the young people expect to find opportunities such as employment and/or education opportunities that are lacking in their home villages.

Figure 2: Population pyramid by single years, FSM: 2010
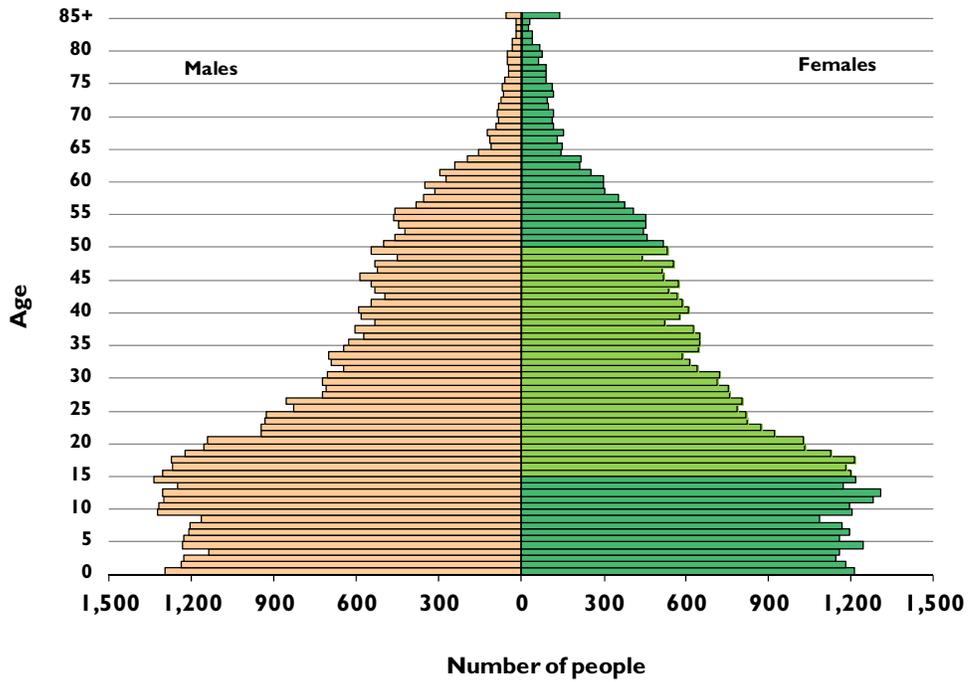
Figure 3: Population pyramid by single years, Urban areas: 2010

Males **Females**

Age

Number of people
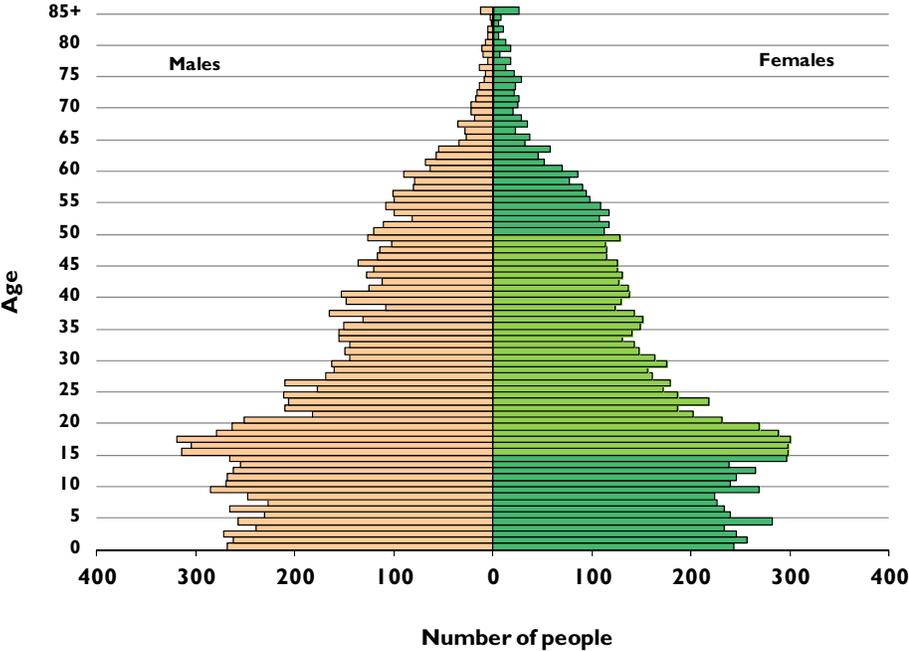
Figure 4: Population pyramid by single years, Rural areas: 2010

Males **Females**

Age

Number of people
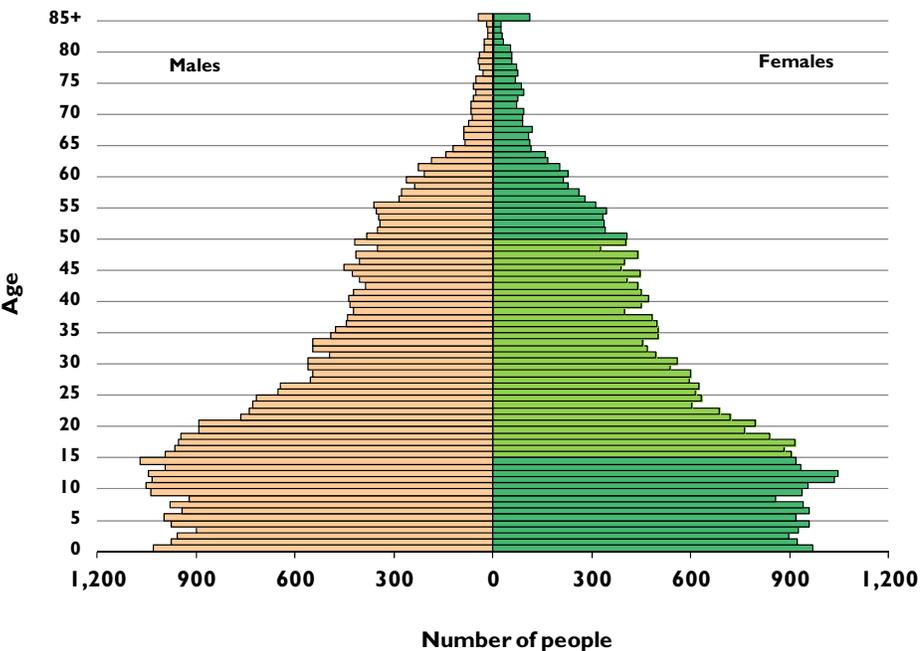
Figure 5: Population pyramid by single years, Yap State: 2010
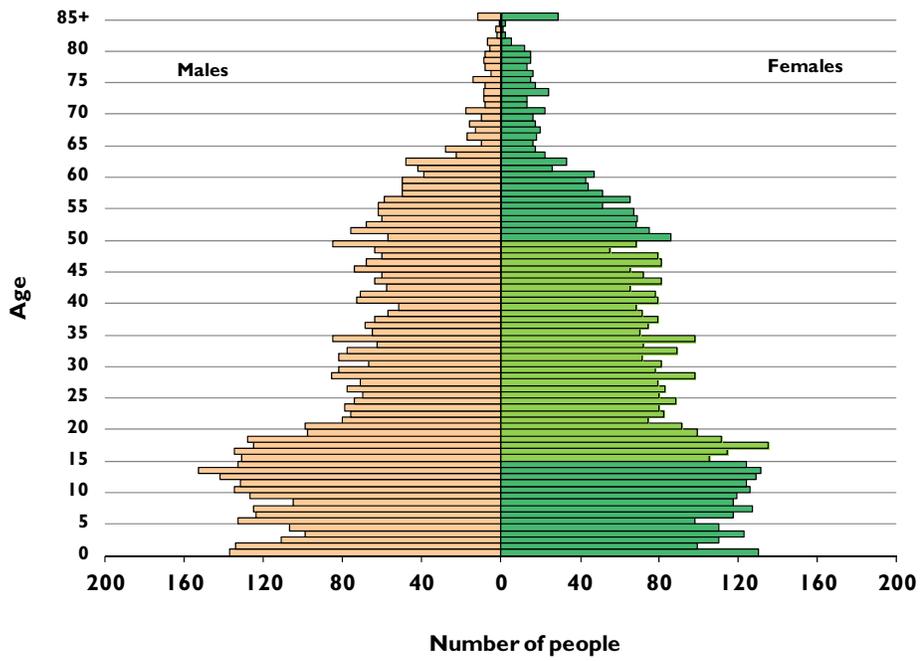
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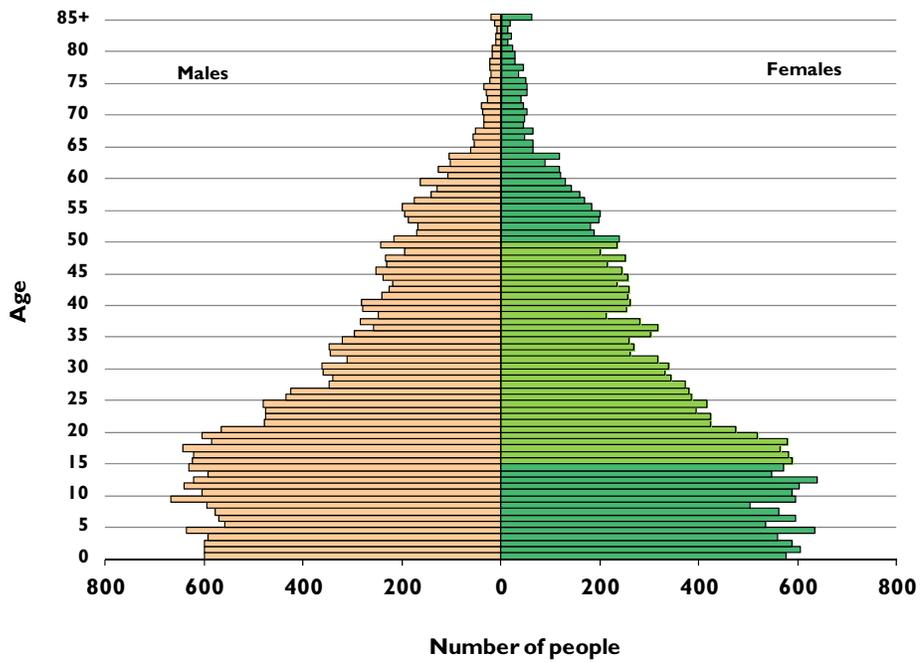
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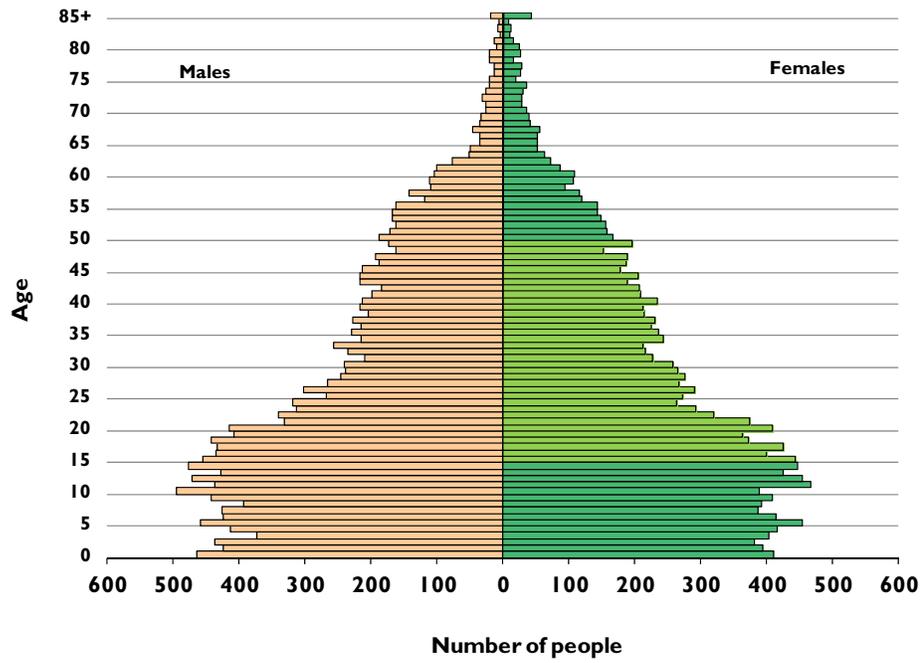
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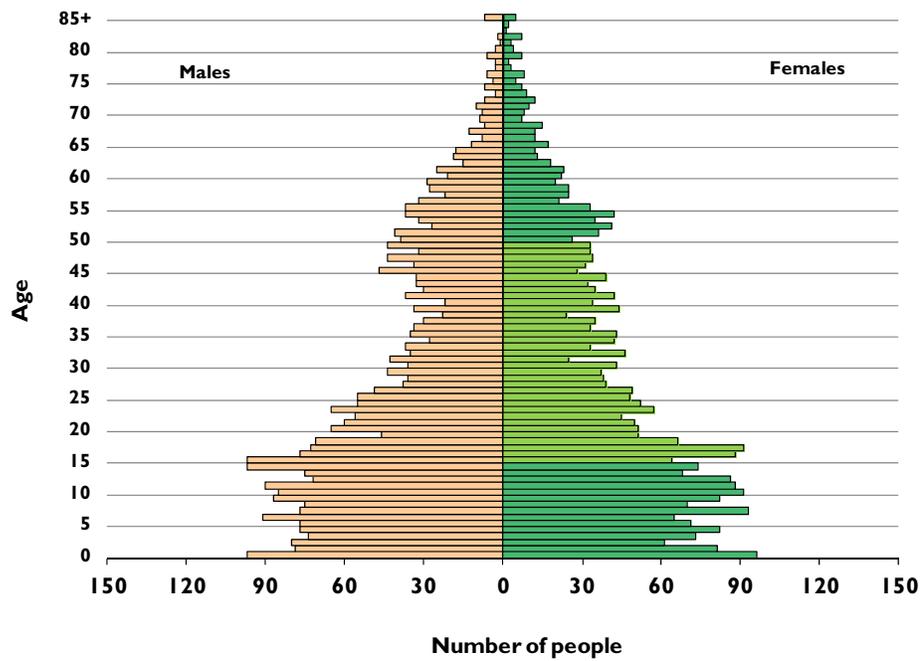
The present study examines the level, trends and differentials in fertility based on the 2010 census and disseminates findings that provide planners and policy-makers timely information to develop socio-economic policies and programmes for the nation and well-being of its people.

> **A note on methodology**
>
> This study is based on current or period fertility, as well as past history of fertility, reported by women in the reproductive ages of 15 to 49. Current fertility estimates are directly obtained from information on the date of birth of the last child to women 15 years and over. As usual, the 2010 census collected information on the total number of children ever born to these women. In order not to misrepresent the adopted or step children, special instructions were given to the enumerators to distinguish children born to the actual mothers from those adopted or step children. The information on total children ever born gathered from all women aged 15 years and over in 2010 enables estimation of cumulative or past fertility, which is computed as the mean children ever born, or mean parity classified by five-year age groups of women. It is to be noted that the completed family size, the mean children ever born to women aged 45-49, would correspond to the Total Fertility Rate under conditions of constant fertility of the population over the past several decades and perfect reporting of fertility data.
>
> In addition, the FSM census continued to gather information on the relationship of mothers with their own children, allowing a unique opportunity to estimate fertility trends for the past 15 years preceding the census by the application of the *own-children method*.

Current estimates of fertility based on the census data are compared with the corresponding data obtained from the Ministry of Health and Vital Registration. Also presented are current estimates of fertility by urban-rural residence, educational attainment and employment status of women. In addition to the current fertility, this study also presents the past fertility or cumulative fertility which is based on the information on children ever born to women in the reproductive ages of 15 to 49. This data is compared with previous census results to show the changes in fertility history by cohorts of women.

Chapter 2 displays fertility levels and trends using unadjusted census data (direct methods). It uses data on women's characteristics who have/have not given birth, average parities, mother-child relationship in terms of their residence, and number of male-female births.

In Chapter 3 fertility levels and trends are examined by using indirect methods, in particular the own-children method, and shows fertility differentials by socio-economic background characteristics of women, as well as an historical trend for each FSM State.

Chapter 4 looks into the completeness of birth registration, while Chapter 5 presents data on the use of contraception.

Finally, chapter 6 summarises the findings and discusses opportunities and challenges likely to be brought by the fertility transition in the FSM (see note on Demographic transition, App.1). This chapter also suggests areas for further research.

1.2 Country profile

1.2.1 Overview

The FSM is an island nation consisting of approximately 607 islands in the Western Pacific Ocean. Although the total area encompassing the FSM, including its Economic Exclusive Zone (EEZ), is very expansive, the total land area is only 271 square miles with an additional 2,776 square miles of lagoon area. The 607 islands vary from large, high mountainous islands of volcanic origin to small flat uninhabited atolls. The FSM consists of four geographically and politically separate States: Chuuk, Kosrae, Pohnpei, and Yap.

The State of Chuuk consists of 15 high volcanic islands in the Chuuk Lagoon and a series of 14 outlying atolls and low islands. There are three geographic aspects to Chuuk, the administrative center of the State on the island of Weno (formerly Moen), the islands of the Chuuk Lagoon, and the islands of the outlying atolls - a total of approximately 290 islands in all. The 15 islands of the Chuuk Lagoon have a total land area of 39 square miles; and the lagoon itself has a total surface area of 822 square miles and is surrounded by 140 miles of coral reef. Because of the vast expanse of water between islands, travel within the State of Chuuk is difficult. Within the lagoon, travel by boat from Weno to any of the other islands will take from 1.5 hours to 2 hours. Access to the outer islands is even more difficult with travel times on a cargo ship taking from four hours up to two days. The provision of health care, including family planning services, to the population of Chuuk is made difficult by the lack of transportation and communication with widely dispersed, small clusters of the populations on outer and lagoon islands.

The State of Kosrae is the only single-island State in the FSM and the furthest south-eastern point of the four FSM States. Kosrae is the second largest inhabited island in the FSM (Pohnpei being the largest) with a land area of approximately 42.3 square miles. Because of the steep rugged mountain peaks, all of the local villages and communities are coastal communities connected by paved roads. Travel around Kosrae island is not difficult and it is possible to drive from one end of the island to the other end in approximately two hours of easy driving. The State is divided into the four municipalities of: Lelu, Malem, Utwe, Tafunsak. The community of Walung (approximate population of 200) is part of Tafunsak municipality, is isolated and only accessible by a ½ hour boat ride at high tide.

The State of Pohnpei consists of the main island of Pohnpei and eight smaller outer islands. The island of Pohnpei, the largest island in the FSM, is approximately 13 miles long with a land mass of 129 square miles. It is subdivided into five municipalities of Madolenihmw, U, Nett, Sokehs, Kitti, and the town of Kolonia where the majority of the government buildings and offices, and the Pohnpei State Hospital are located. Of the outer islands of Pohnpei, to the south lies Kapingamarangi (410 miles from Pohnpei proper), Nukuoro (308 miles), Sapwuahfik (100 miles), Oroluk (190 miles), Pakin (28 miles), and Ant (21 miles). To the east lie the islands of Mwoakilloa (95 miles) and Pingelap (155 miles). These outer islands together comprise a land mass of approximately 133 square miles and 331 square miles of lagoons. Travel to outlying communities on the island of Pohnpei proper is becoming easier with the completion of pavement of the road around the island. However, because of scattered housing along feeder unpaved dirt roads, there are still many residents who have difficulties in accessing health care including family planning. The outer islands are the most difficult to reach because of the infrequent and undependable cargo ships. The regular shipping service is once a month to each of the outer islands.

The State of Yap lies in the western most part of the Federated States of Micronesia. Yap proper is the primary area in Yap State and is a cluster of four islands (Yap, Gagil-Tomil, Maap, Rumung) connected by roads, waterways, and channels. The town of Colonia on Yap proper is the capital. Yap has a total of 78 outer islands stretching nearly 600 miles east of Yap Proper Island of which 22 islands are inhabited. Although these islands encompass approximately 500,000 square miles of area in the Western Caroline Island chain, Yap State consists of only 45.8 square miles of land area. Most of the outer islands are coral atolls and are sparsely populated. Transportation on Yap Proper is easier because of the development of paved roads; however, there are clusters of villages that are still inaccessible to health and family planning services because of unpaved dirt roads. The outer islands are also difficult to reach because of infrequent cargo ships. The regular shipping schedule is once a month to each of the outer islands bringing supplies and health personnel to deliver goods and services.

The FSM is vulnerable to severe weather events, such as cyclones, tsunamis, and tidal surges. The low-lying atolls are the most vulnerable, but high islands are subject to coastal erosion, especially with urbanization. Future climate change could have serious consequences for FSM's population as well as marine eco-system and coastal areas, as in other atoll countries.

The FSM's economy remains dominated by the public sector. Over 50% of the labor force is employed in public administration or State-owned enterprises and the government sector generates 40% of gross domestic product (GDP). Despite the combined efforts of the FSM Government, the U.S. Government and various development partners, little new private sector investment has occurred.

The proportion of the population in basic needs poverty has increased significantly between the last two HIESs. The proportion of the FSM population falling below the "basic needs" poverty line increased from 28% in 1998 to 30% in 2005—effectively an 11% increase. Similarly, the number of households living below the food poverty line (the absolute poor) has increased from 11 to 13% over the same period. Poverty rates also vary across the States. Kosrae had the highest poverty rate (34.5%) and Yap the lowest (19.4%), but food poverty was highest in Chuuk (12.2%) and lowest in Yap (4.0%). In FSM, the individuals living below the national poverty line tend to have low educational achievement and live in households without a wage or salary worker and/or are headed by a female. The impoverished include the unemployed, the uneducated, the landless, teenage couples with children, widows and widowers and households with many children who lack support from an extended family. Thus the need for family planning among the poor remains high.

1.2.2 Socio-cultural factors affecting population

The FSM, a society in rapid transition, is composed of four different societies with twelve different major languages. These languages are Kosraean in Kosrae; Pohnpeian, Kapingamarangian, Nukuoran, Mortlockese, Mokilese Ngatikese and Pingelapese in Pohnpei; Chuukese and Mortlockese in Chuuk; and Yapese and Ulithian in Yap. English, however, is the official language of the governments and is taught in the schools. Additionally, many older people are familiar with the Japanese language.

In Kosrae, the Congregationalists largely influence its culture, a religious group who came from the Boston area of the United States during the late 1800's. Countries, which added their own influence during the 1900's included Spain, Germany, Japan and the United States.

Although there are a number of minor differences in cultural patterns between the State center and the outlying islands, the State of Chuuk is composed of people who basically share one culture and one language.

Pohnpei has six distinct cultural groups. They are Pohnpeians; Mortlockese, a group of people, from the outer islands of Chuuk State, who sought refuge in Pohnpei after the typhoon of 1905; Polynesians from Kapingamarangi and Nukuoro; and Pingelapese, Mokilese and Ngatikese on the atolls of Pingelap, Mwokilloa and Sapwuafik, respectively.

In Yap, there are two major cultural groups and two major languages. The inhabitants of Yap Proper speak Yapese and belong to one culture while the inhabitants of the outer islands speak a language of Chuukese origin and share the Chuukese outer islands culture.

Cultural attitudes and practices continue to influence the impact of the health care delivery system and the health status of FSM residents. Many islanders have not completely understood the concept of medical confidentiality and some people continue to be reluctant to be seen or examined by the physician, nurse or health aide. In small communities, almost everybody is related to one another and it is considered culturally unacceptable for relatives to see each other's private parts. Because of their reluctance as well as lack of understanding of preventive measures, some people only seek medical care when they have to and when it is too late. Many women are reluctant to undergo gynaecological examinations by a male health care provider. In outer islands, most of the health assistants and medexes are males to whom the majority of the women in the community are related. Post-natal clinics in public health programs are often impeded because of a belief that women should not be seen or examined after delivery until the bleeding has completely ceased. Many Micronesians continue to believe that certain illnesses or diseases are brought upon a person by gods and/or ancestors for various reasons (such as punishment of certain members of the family or clan who have offended the gods or ancestors). Because of such beliefs, certain illnesses are believed to be remedied only by reconciliation with the gods, families or individuals and cannot be remedied by Western medicine.

In some Micronesian cultures, certain castes of people cannot hold high positions in society. This has presented problems to members of low-caste clans who have achieved high levels of skills and education only to have their authorities and responsibilities ignored by members of the society's higher castes.

These factors and others affect the health of Micronesians and concomitant efforts to alter behavior generally meet with resistance. A large number of adults cannot read or write English although they can read, write and speak Japanese. Various orthographies have been developed for the major local languages, but it is estimated that only one-half of the adult population (over the age of 40) can read and write in their own languages. Thus, health education in the modern sense has not been always part of the curriculum, nor part of the local cultures. Strong conservative attitudes held by adults, language and logistic problems impact health education, including sexuality and family planning education.

2 Census information - direct methods

2.1 Number of live births

The very first fertility-related question asked in a census is whether a woman has ever given birth to a living baby[1], and if so, how many.

The proportion of women who gave birth to at least one child increases with age. While 94% of (teenage) women had not (yet) given birth, it was about two-third of women aged 20-24 years. At age 45-49 years, 15% of all women in this age group had not given birth (Figs.9-13). These women will in all likelihood remain childless as they reached the end of their reproductive years. The census does not provide information to determine whether these women remained childless voluntarily or involuntarily.

The occurrence of **childlessness** varies somewhat among the different FSM States; while 13% of Yapese women remained childless, it was 19% in Chuuk, 13% in Pohnpei, and only 7% in Kosrae.

However, the vast majority of women gave birth more than once. At age 20-24 years about 15% of all women had 2 children or more, at age 30-34 years more than a quarter of all women had at least 4 children, and at age 45-49 years 21% of women had 7 children or more, and 5% had 10 children or more.

The proportion of women aged 45-49 years who gave birth to 7 children or more differs from State to State: while only 12% of women in Yap of this age group had 7 children or more, it was with 27% much higher in Chuuk. The corresponding percentages were 17% in Pohnpei and 21% in Kosrae.

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[1]A live birth is defined by the World Health Organization to be the complete expulsion or extraction from the mother of a baby, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of the voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached. Each product of such a birth is considered live born.

Figure 9: Proportion of women by age group and number of children born, FSM: 2010
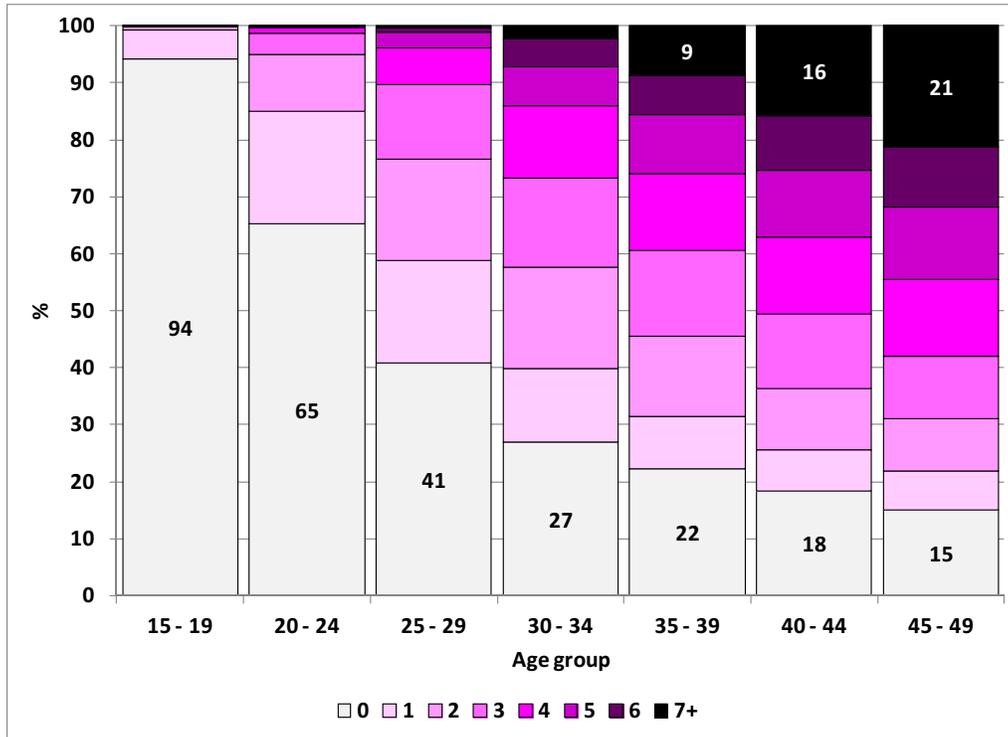
Figure 10: Proportion of women by age group and number of children born, Yap State: 2010
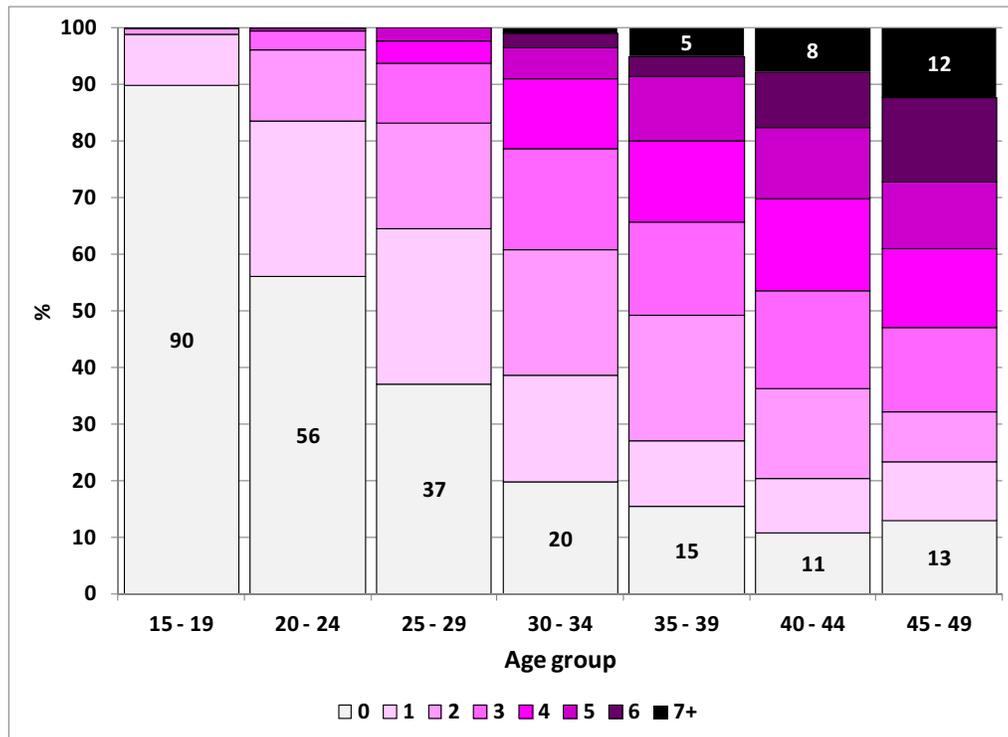
Figure 11: Proportion of women by age group and number of children born, Chuuk State: 2010
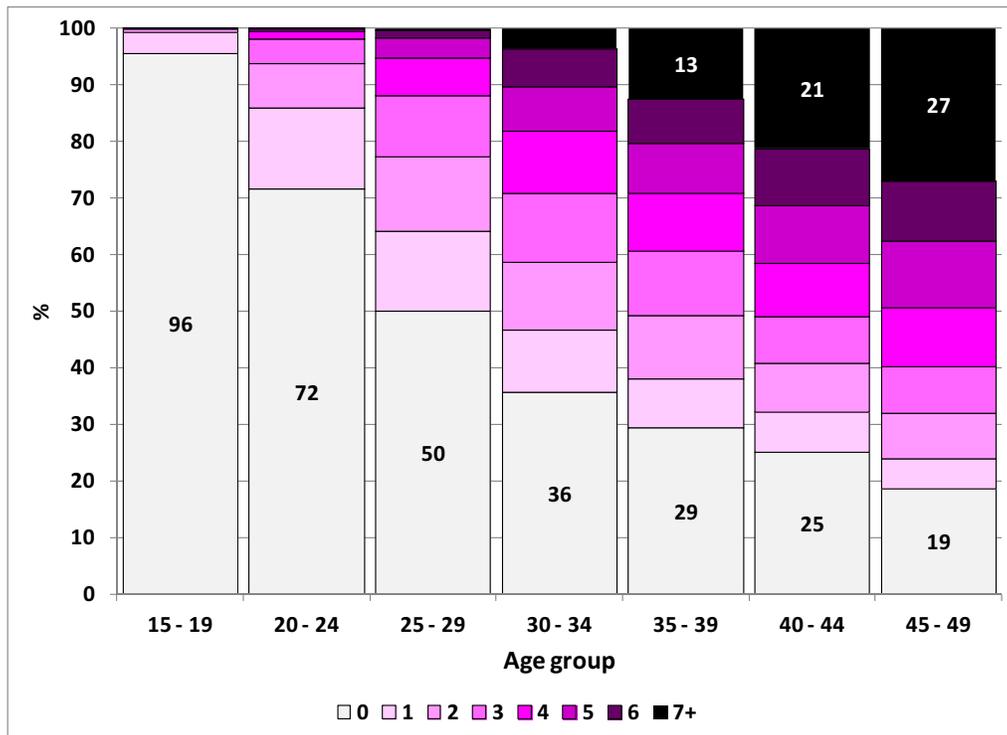
Figure 12: Proportion of women by age group and number of children born, Pohnpei State: 2010
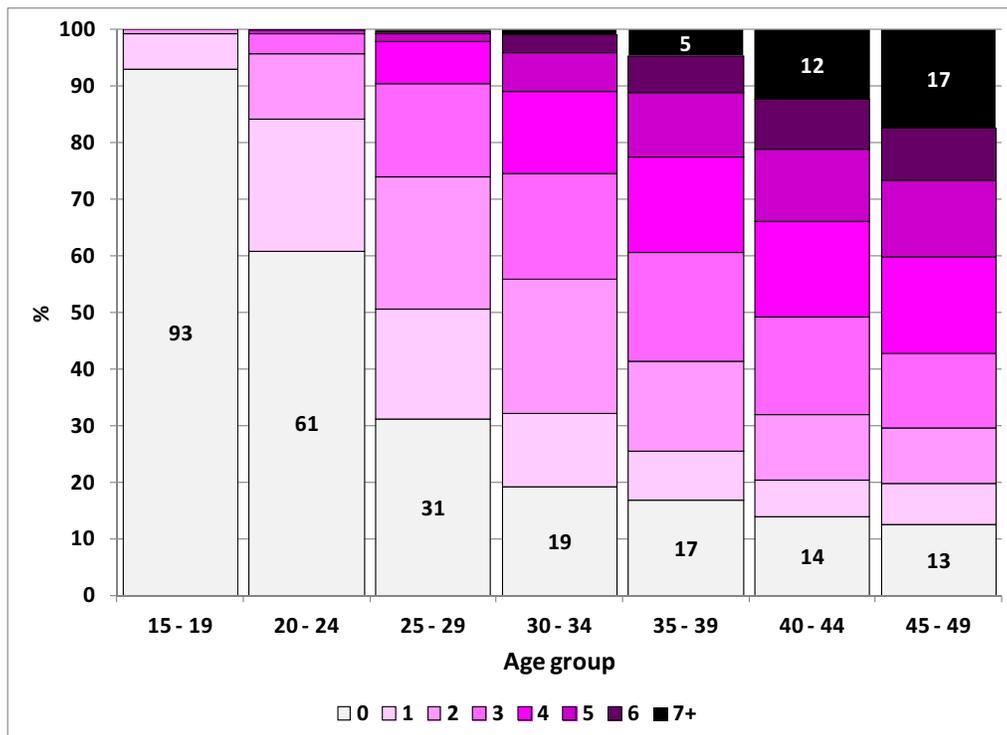
Figure 13: Proportion of women by age group and number of children born, Kosrae State: 2010
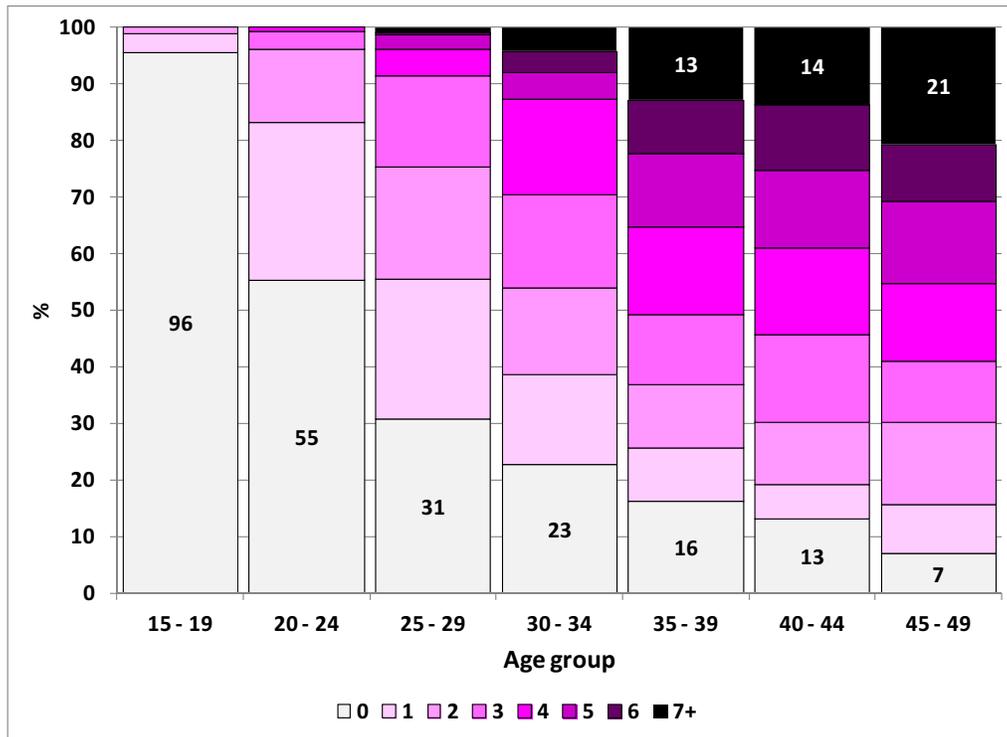
2.1.1 Childbearing and marital status

This section examines the available 2010 census data for the relationship between childbearing and marital status. Whereas a seemingly small proportion of all women who gave birth were never married (single), it is a considerable proportion of younger women (Fig.14).

Perhaps not surprisingly, the majority of teenage women who gave birth were never married, and even for women aged 20-24 a noticeable proportion was not married. It can be concluded that childbearing often occurs before marriage.

Comparing data of women who had given birth (at least once) by marital status (Fig.15) to those who had never given birth (Fig.16) shows marked differences in marital status.

The likelihood of women who have given birth to be married is much higher than women who never gave birth; a noticeably high proportion of women who never gave birth remain single (never married). While about half of all women aged 15-19 who gave birth were already married, it was only 6% of women of the same age who did not give birth (yet). At age 25-29 years, only 20% of women who gave birth remained never married compared to 63% of women who never gave birth. Overall, less than 4% of women aged 50 years and older who gave birth remained single compared to about one-quarter of women who never gave birth.

Figure 14: Proportion of females by age, whether given birth and by marital status (%), FSM: 2010
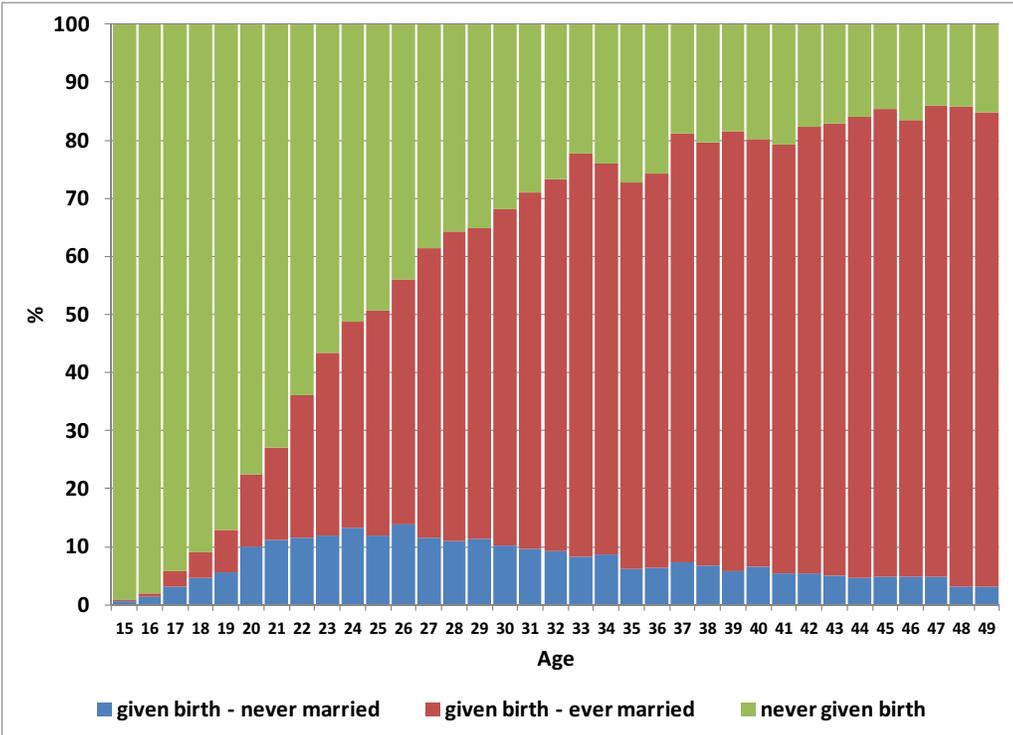
Figure 15: Females by age group who gave birth by marital status (%), FSM: 2010
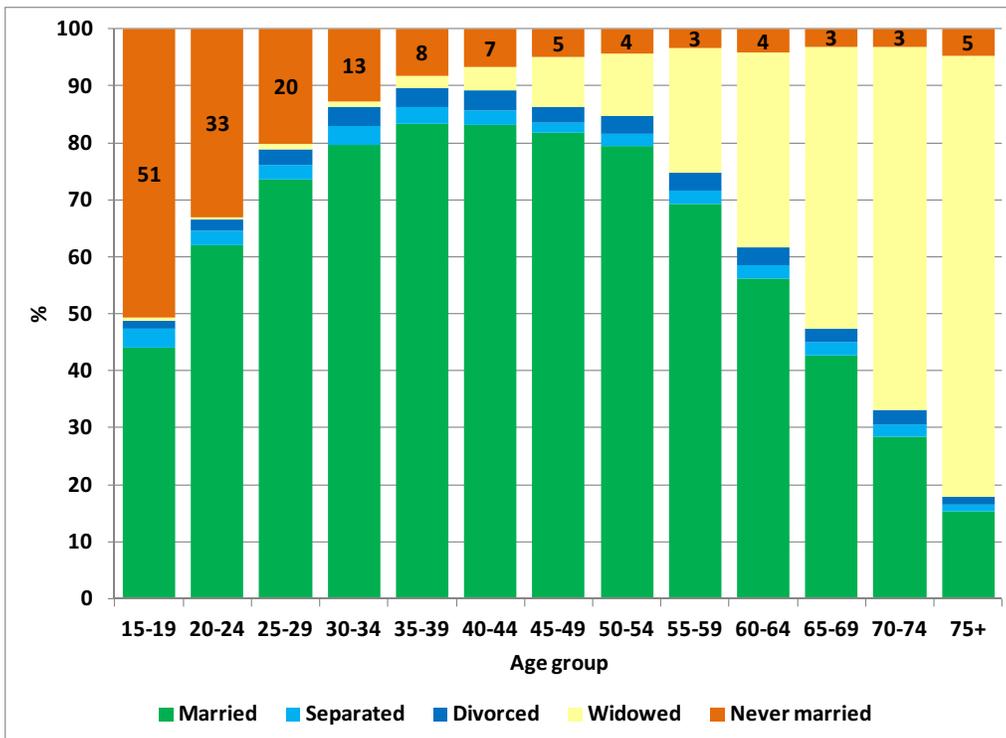
Figure 16: Females by age group who never gave birth by marital status (%), FSM: 2010
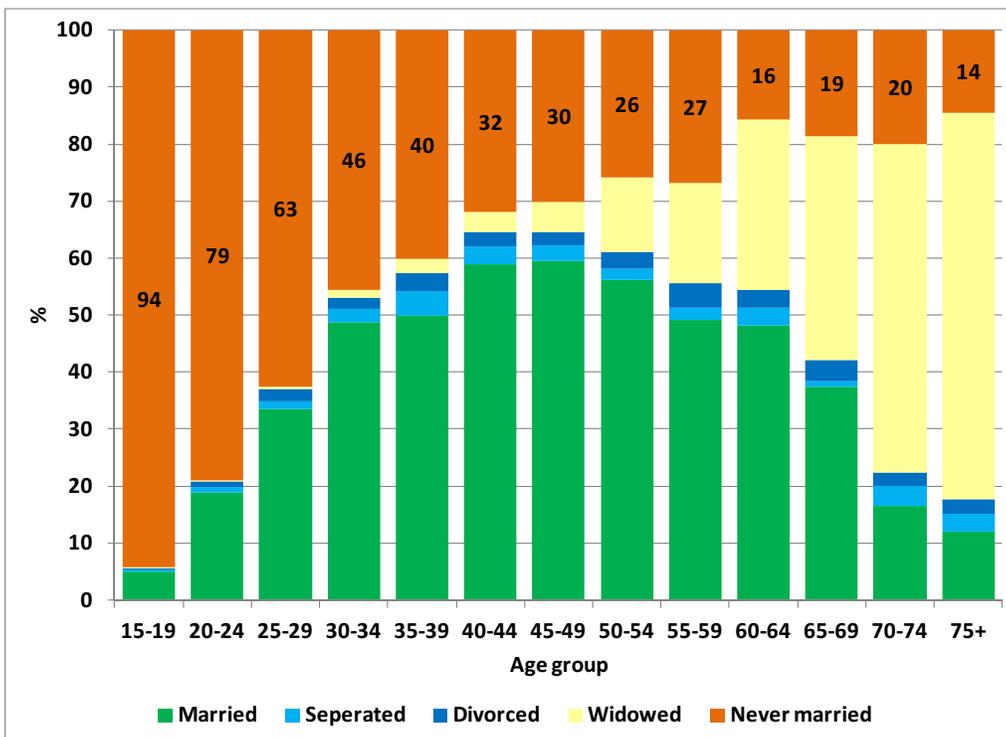
2.1.2 Childbearing and school enrolment

This section examines the available 2010 census data for the relationship between childbearing of young women aged 15-24 years and school enrolment. The data show striking results: school enrolment rates of teenage women aged 15-19 years who had not (yet) given birth are much higher compared to those women who had given birth (Fig.17). While more than 70% of women aged 15-17 years who had not given birth were in school, it was less than 30% of women who had already given birth.

Also at ages 20 years and older, school enrolment rates of women who had never given birth were at least twice as high as those women who had given birth.

These data clearly show the impact of early childbearing on women's educational background: women who have children at an early age are likely to drop out of school, and their educational level will be lower than women who did not give birth at an early age. Furthermore, their lower educational status will have an impact on their future employment and income prospects.

Figure 17: Females by age enrolled in school, and whether given birth (%), FSM: 2010
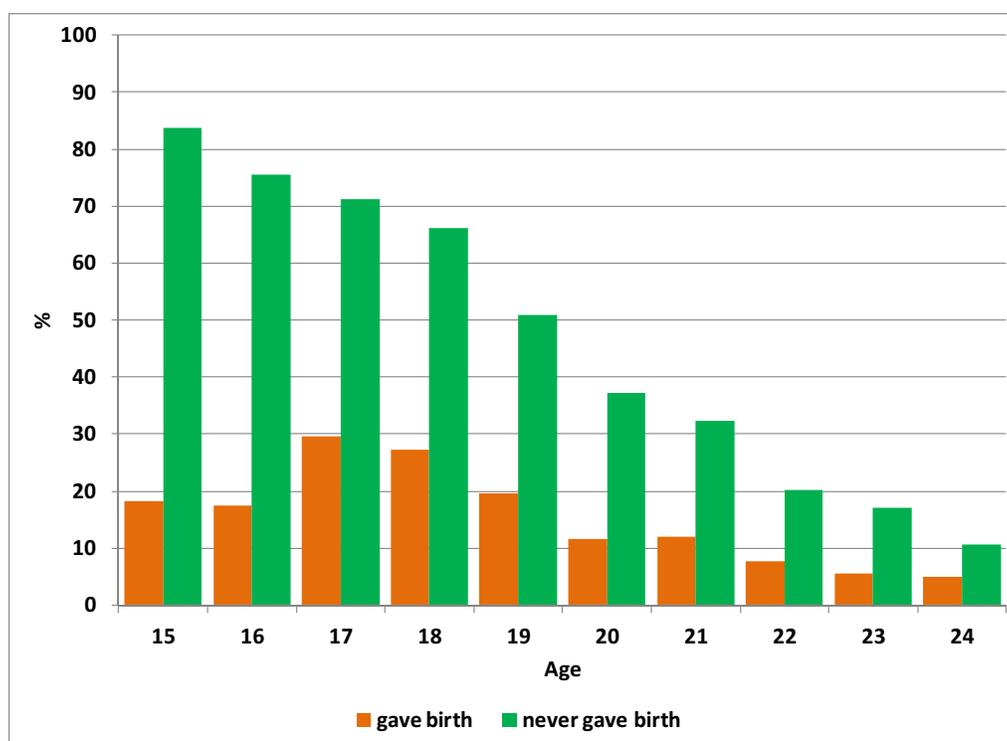
2.2 Average parity

This section examines past fertility or cumulative fertility history of women, which is measured by computing the mean number of children ever born to women classified by five-year age groups. The number of children ever born is also known as a woman's '*parity*. The mean parity for women aged 45-49 provides an indication of completed fertility as this represents the cumulative fertility experience of women who approach the end of their reproductive life.

Average parity

The average number of children ever born or average parity is obtained by dividing the total number of children ever born to women in a specified age group by the total number of women in the same age group.

The total number of live-births to 32,750 women aged 15 and older was 82,814; 42,931 males and 39,883 females (Table 1). The average number of live-births to all women was 2.5 children per woman (average parity).

Average parity increases with the age of women. While women aged 15–19 had only very few children, women aged 45–49 had 4.2 children, and women older than 70 had on average about 6 children. The average parities of women over 49 years of age is also called the **completed fertility rate,** a cohort measure demonstrating how many children a certain cohort of women who have completed their childbearing actually produced during those years.

Table 1: Female population aged 15 and older by number of live-births, FSM: 2010

Age of women	Number of women	Number of live births			Average number of live births		
		Total	Males	Females	Total	Males	Females
15–19	5,750	392	196	196	0.1	0.0	0.0
20–24	4,455	2,529	1,310	1,219	0.6	0.3	0.3
25–29	3,805	5,309	2,679	2,630	1.4	0.7	0.7
30–34	3,194	7,268	3,762	3,506	2.3	1.2	1.1
35–39	3,019	8,993	4,626	4,367	3.0	1.5	1.4
40–44	2,864	10,658	5,563	5,095	3.7	1.9	1.8
45–49	2,549	10,784	5,606	5,178	4.2	2.2	2.0
50–54	2,322	10,777	5,666	5,111	4.6	2.4	2.2
55–59	1,737	8,782	4,530	4,252	5.1	2.6	2.4
60–64	1,123	6,137	3,207	2,930	5.5	2.9	2.6
65–69	657	3,742	1,972	1,770	5.7	3.0	2.7
70-74	537	3,274	1,708	1,566	6.1	3.2	2.9
75+	738	4,169	2,106	2,063	5.6	2.9	2.8
Total	**32,750**	**82,814**	**42,931**	**39,883**	**2.5**	**1.3**	**1.2**

Figure 18 shows a comparison of the reported average number of live-births of the last three censuses. A fertility decline is apparent as the average number of live-births per woman at every age declined from one census to the next. While the average number of live-births per women aged 45-49 years was 6.3 in 1994, it declined to 5.7 and 4.2 in 2000 and 2010. This fertility decline was apparent in all the FSM States, although the pace of decline as well as the level varied from State to State (Figs.19-22).

Throughout the years, the average parities were noticeably lower in the State of Yap , while in 1994 and 2000 it was highest in Chuuk, although for age groups 20-29 it was highest in Pohnpei State.

The difference in average parities among the different States in 2010 narrowed, and Kosrae has slightly higher average parities, especially at age 35-39 years compared to the other States (Figs.23-25)

Figure 18: Female population aged 15-49 by average number of live-births, FSM: 1994, 2000, and 2010
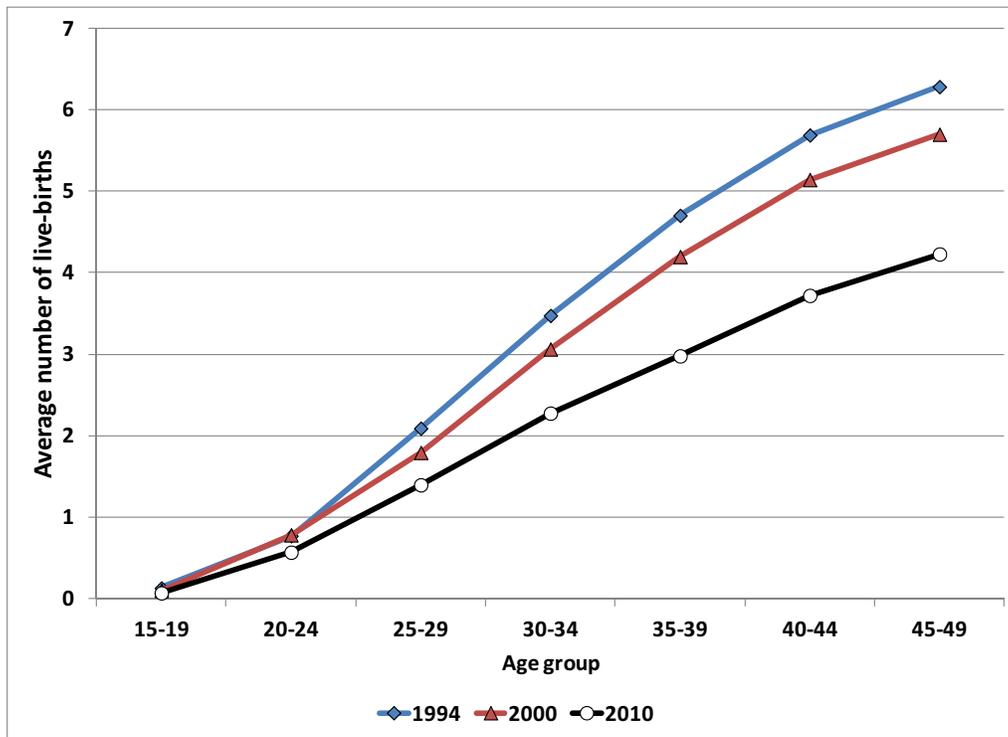
Figure 19: Female population aged 15-49 by average number of live-births, Yap: 1994, 2000, and 2010
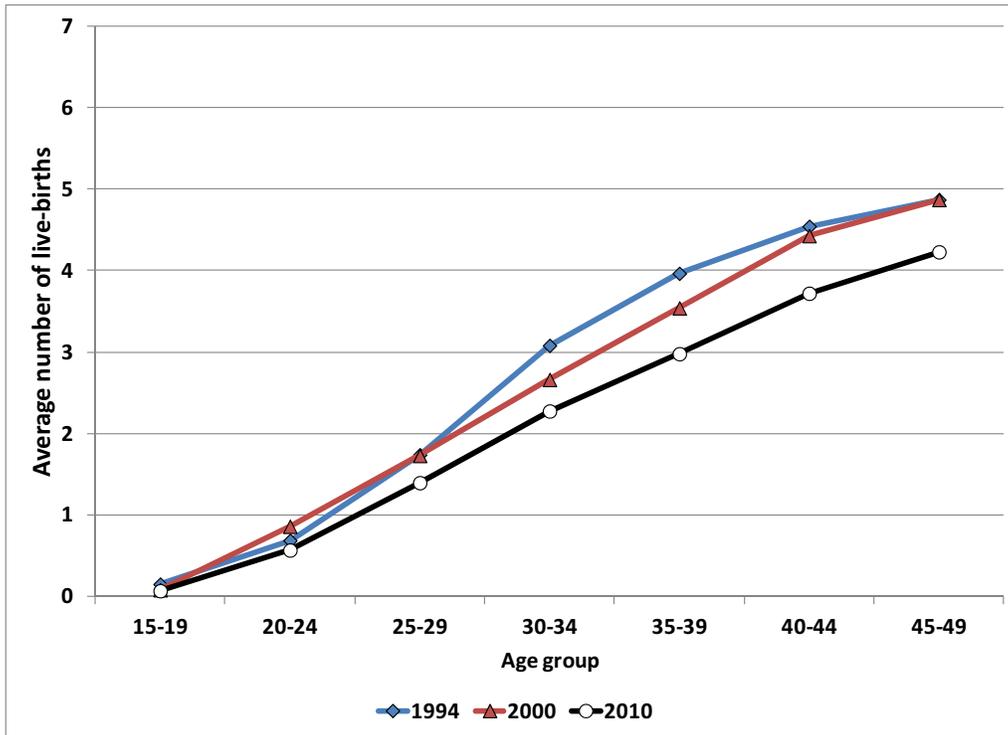
Figure 20: Female population aged 15-49 by average number of live-births, Chuuk: 1994, 2000, and 2010
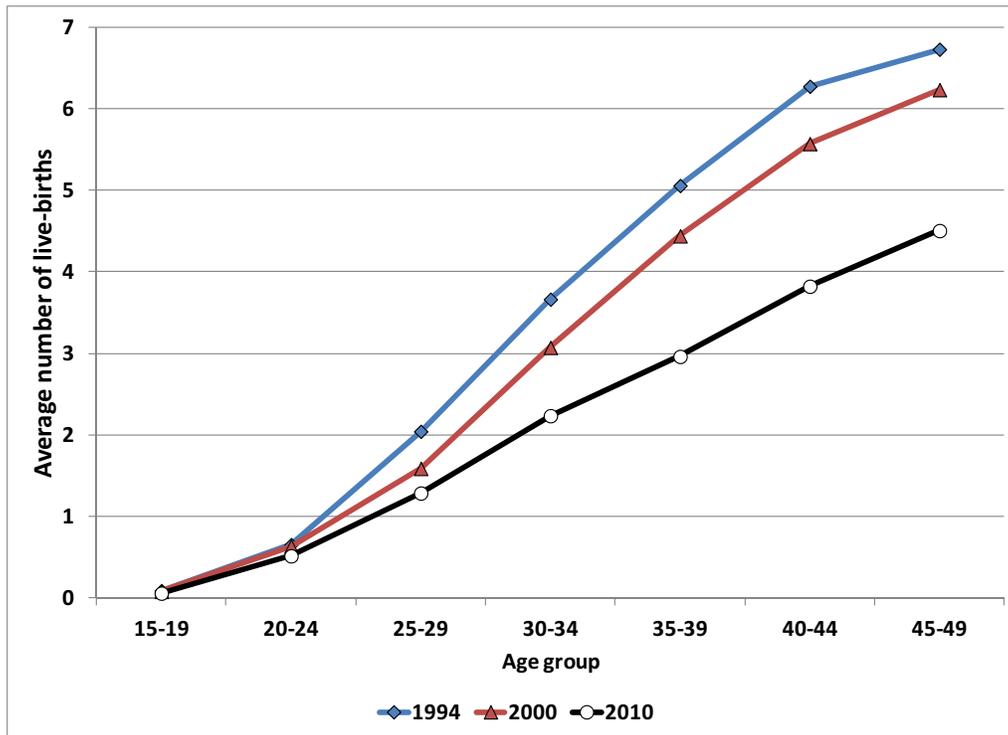
Figure 21: Female population aged 15-49 by average number of live-births, Pohnpei: 1994, 2000, and 2010
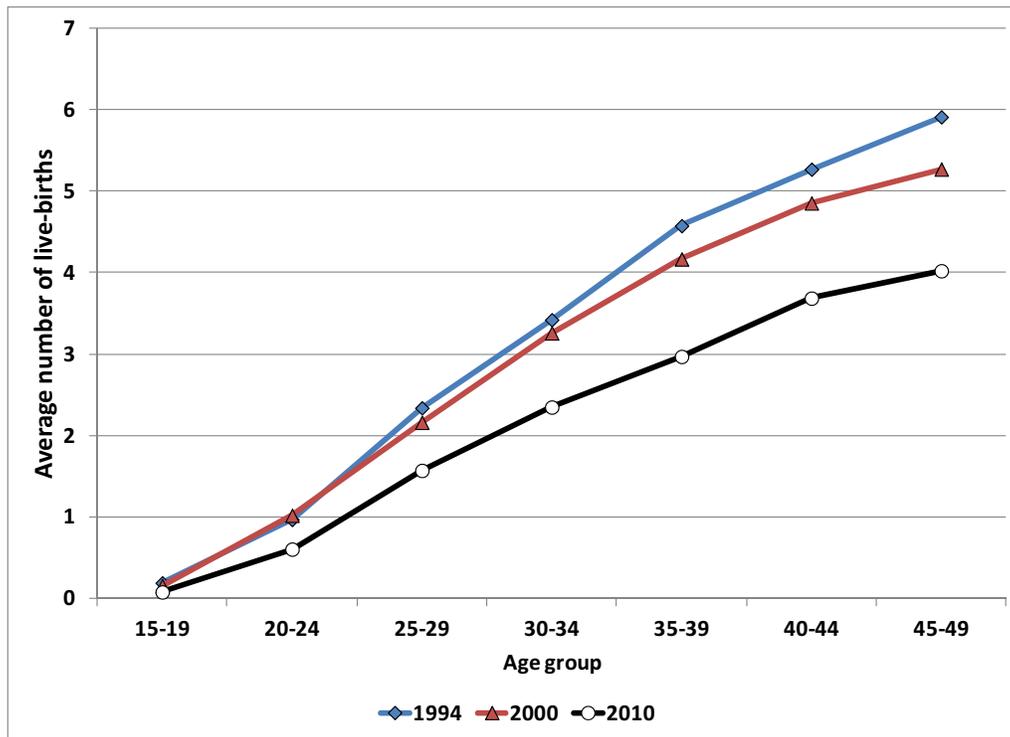
Figure 22: Female population aged 15-49 by average number of live-births, Kosrae: 1994, 2000, and 2010
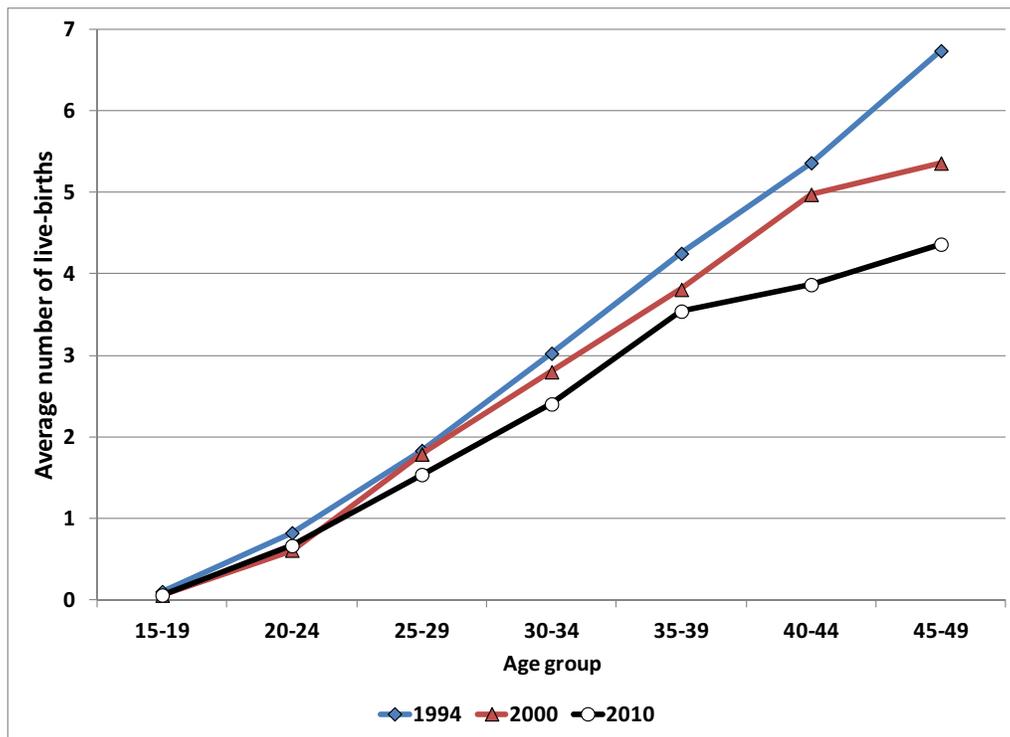
Figure 23: Female population aged 15-49 by average number of live-births and State, FSM: 1994
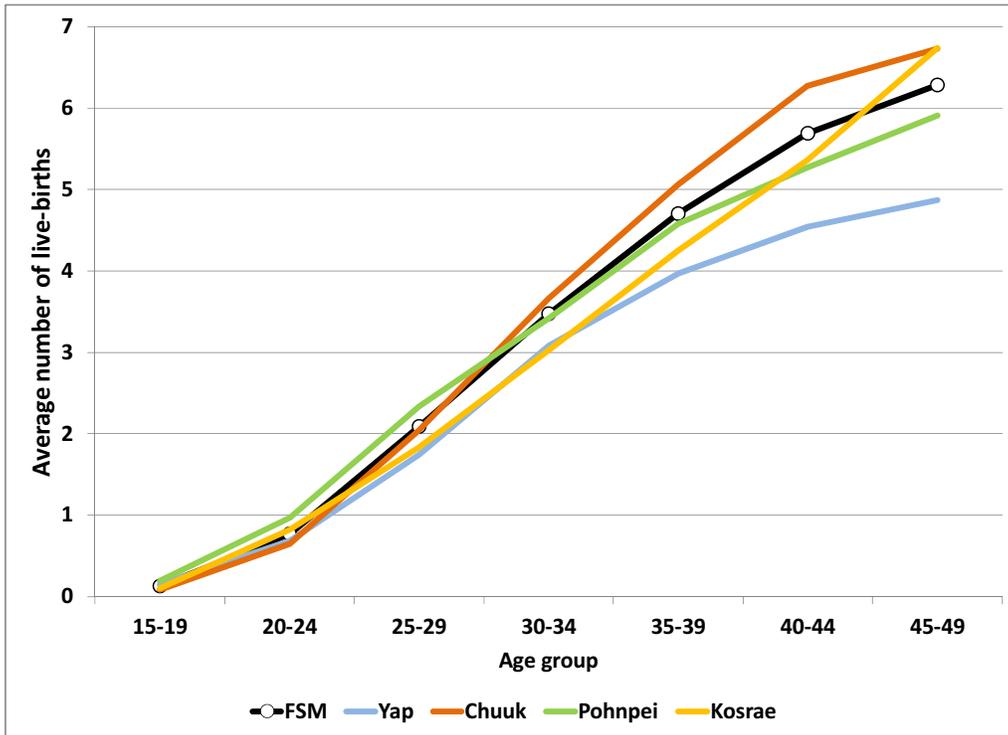
Figure 24: Female population aged 15-49 by average number of live-births and State, FSM: 2000
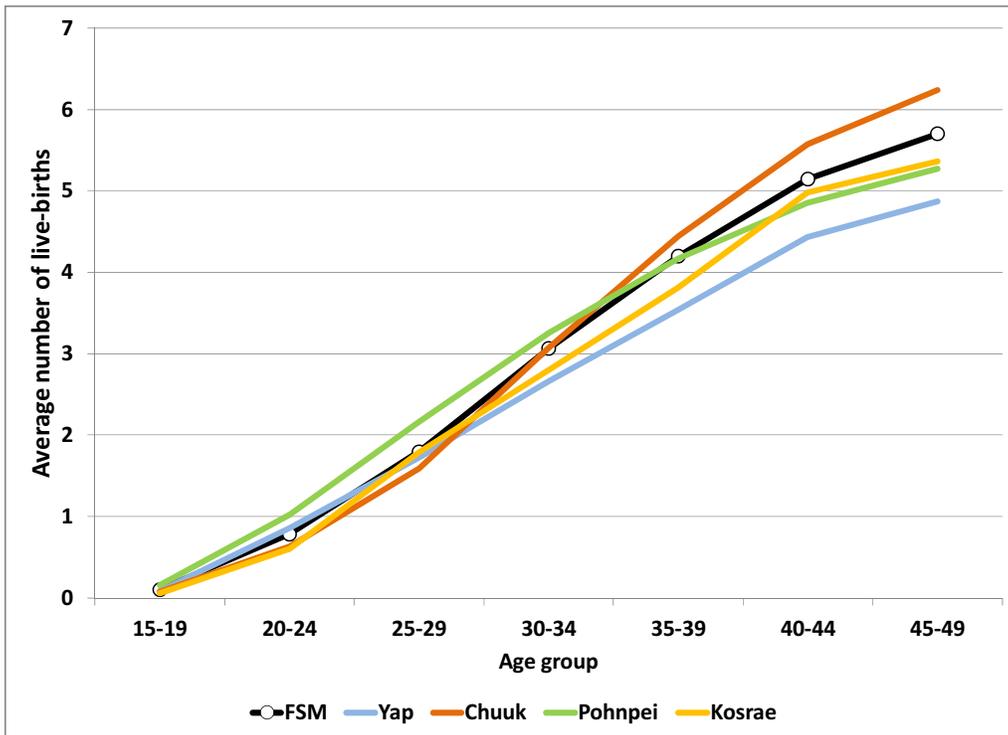
Figure 25: Female population aged 15-49 by average number of live-births and State, FSM: 2010
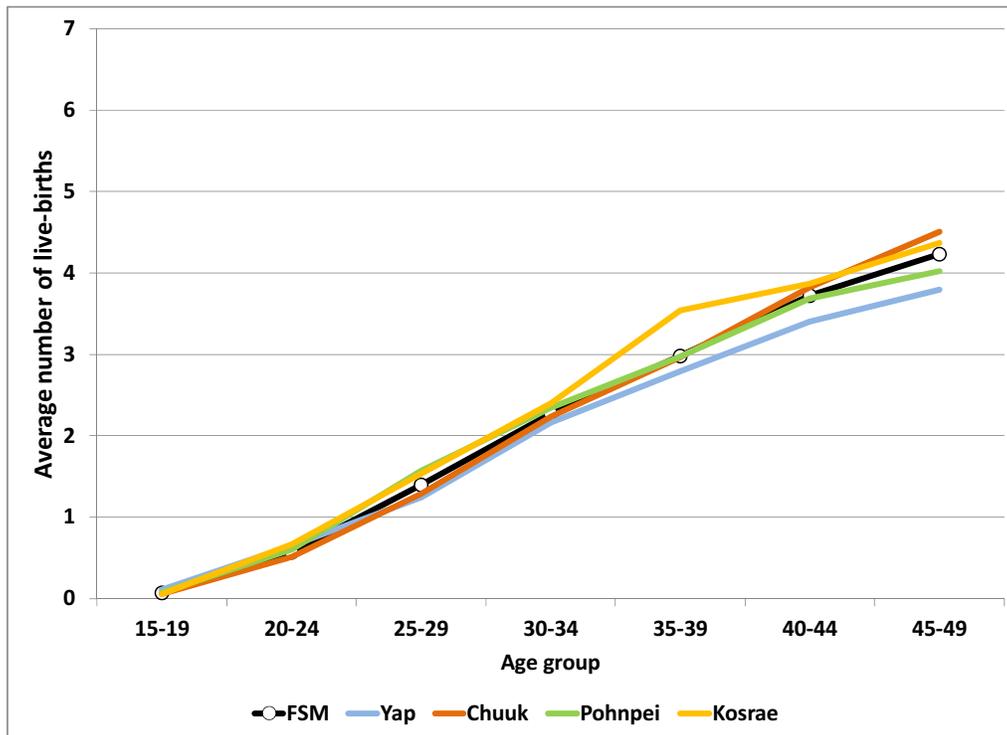
2.3 Mother-child relationship in terms of residence

The census also included questions on where a mother's children lived; whether they lived with her in her household, or in a household elsewhere in the FSM, or overseas, or whether any of her children had died (Fig.26).

The proportion of children living in their mother's household decreased with the age of the mother. This pattern is to be expected because as children grow older they tend to leave their parents' home and form their own household.

While more than 90% of children of mothers aged 24 years or younger lived in their mother's household, only about half of children of mothers aged 50-54 years lived with her. However, still a quarter of all children still lived with their mother when she was 75 years or older.

There was some noticeable variation among States (Figs.27-30). Whereas a relatively higher proportion of children in Chuuk lived with their mothers – even at older ages, this proportion was relatively low in Yap.

Interestingly there was a high proportion of Kosraean children living overseas. 36% of children of Kosraean mothers aged 45 years and older lived overseas.

Figure 26: Proportion of live-births by age of mother and whether living in the same household as their mother, FSM: 2010
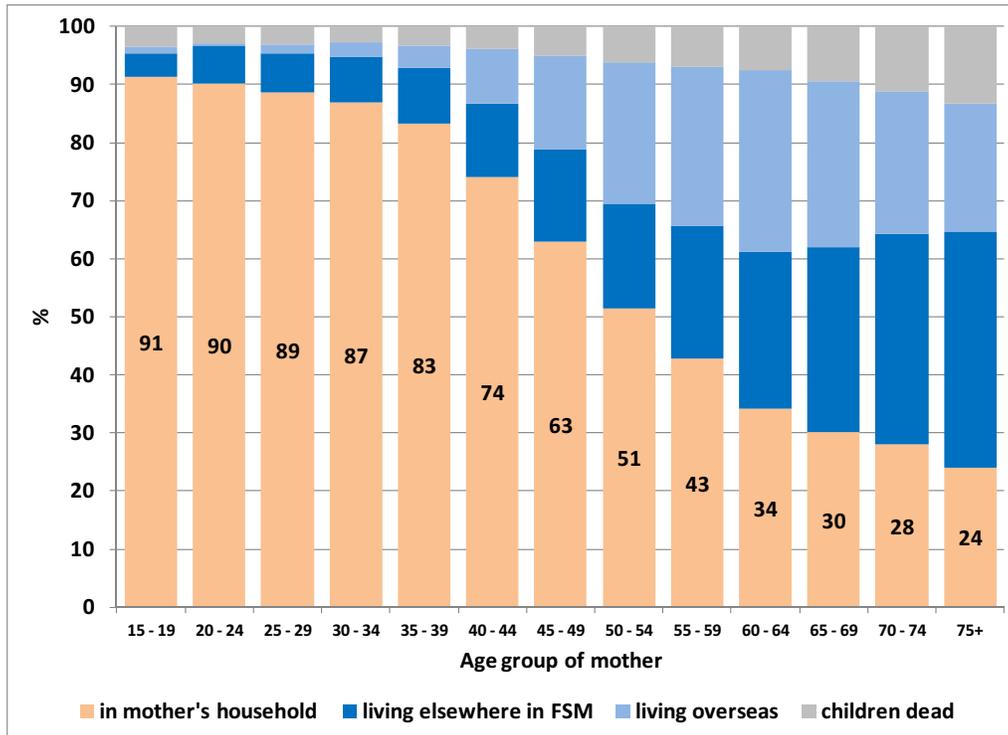
Figure 27: Proportion of live-births by age of mother and whether living in the same household as their mother, Yap: 2010
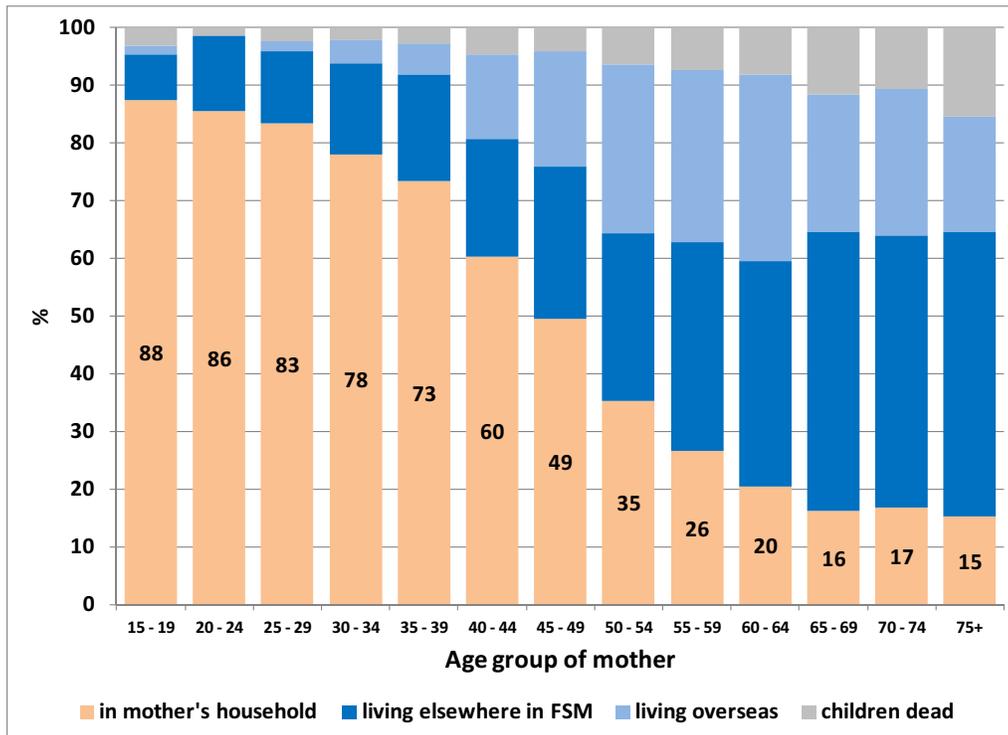
Figure 28: Proportion of live-births by age of mother and whether living in the same household as their mother, Chuuk: 2010
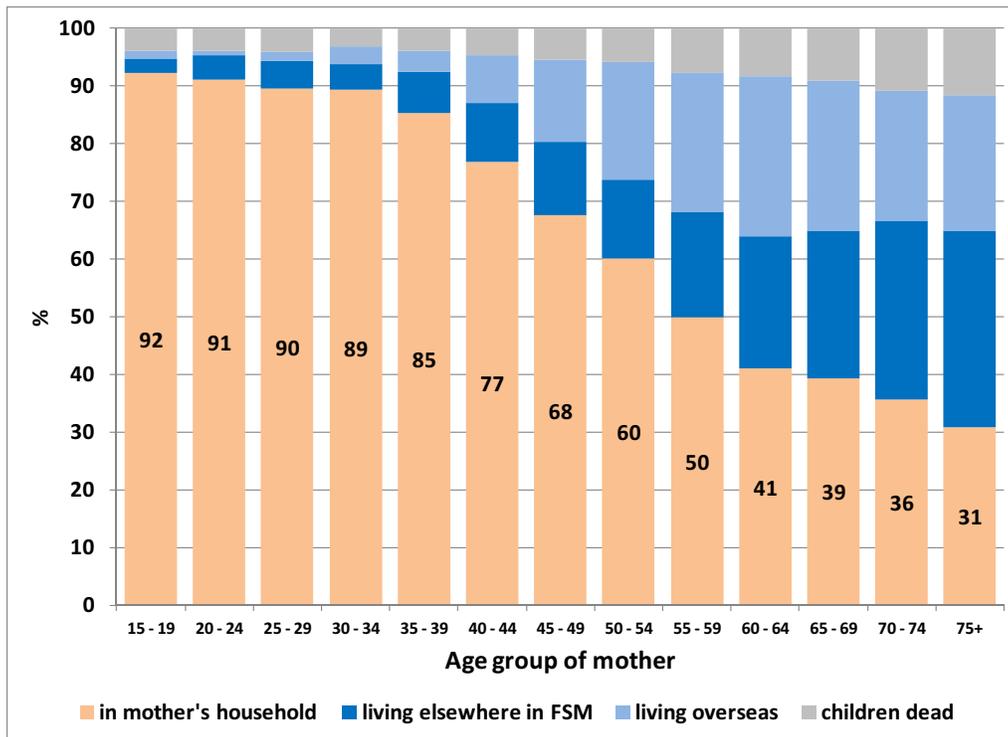
Figure 29: Proportion of live-births by age of mother and whether living in the same household as their mother, Pohnpei: 2010
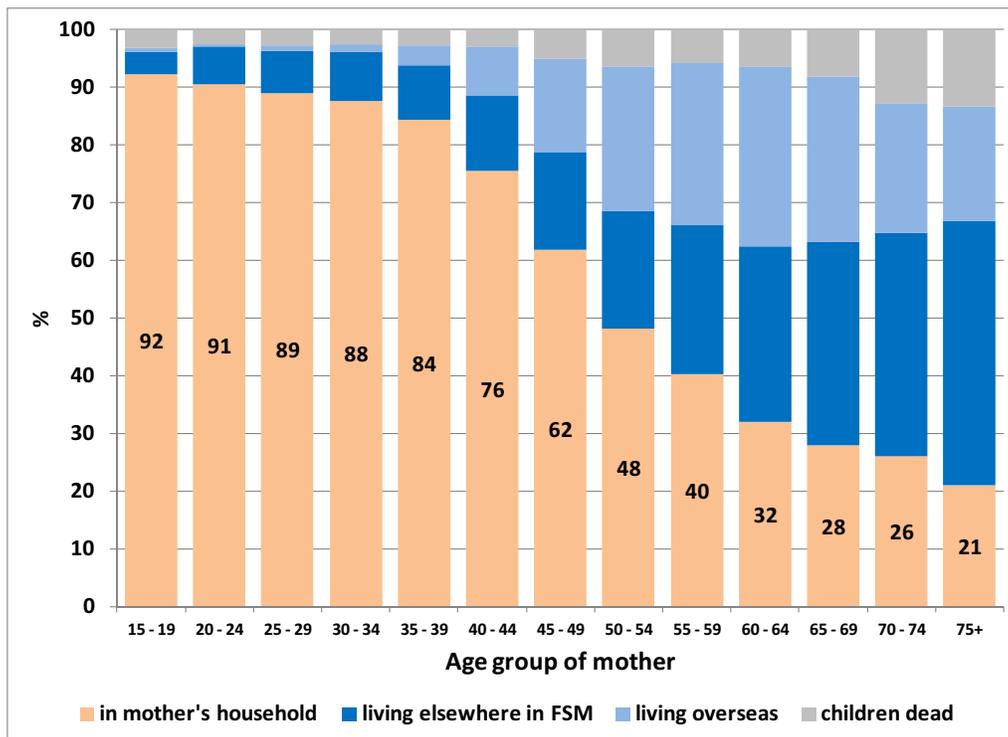
Figure 30: Proportion of live-births by age of mother and whether living in the same household as their mother, Kosrae: 2010
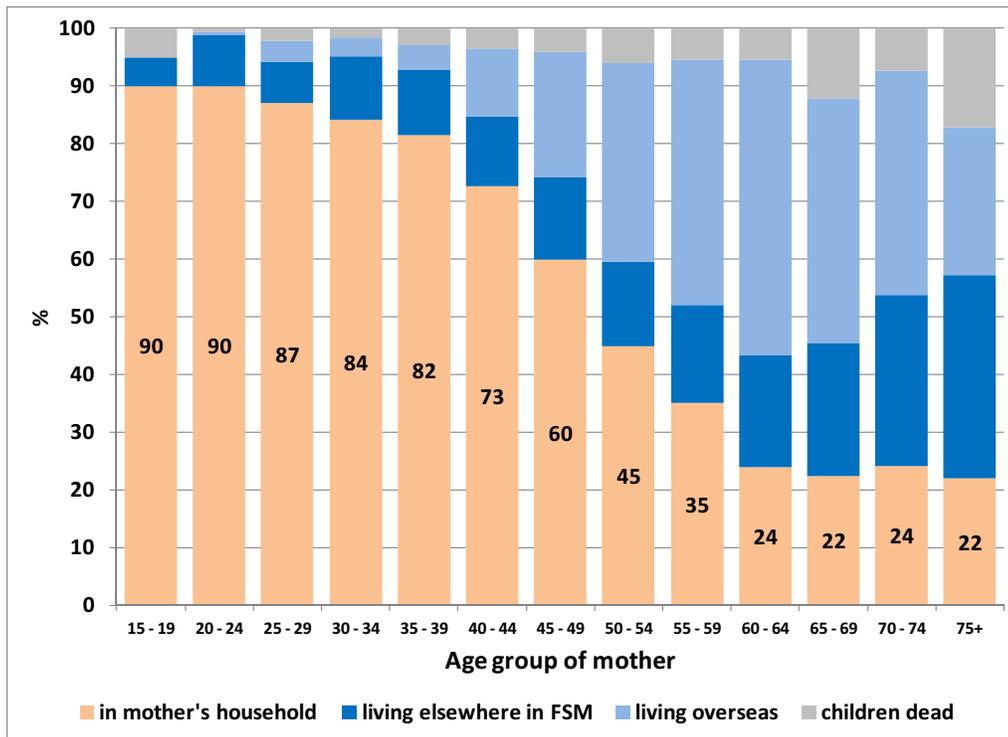
2.4 Reported number of births during 1-year period before the census - Age-specific and Total Fertility Rate

From the question on date of birth of the last born child, the number of births per year or period can be calculated (Table 2). Responses from women during the 2010 census indicated that 2,281 children were born during the one-year period prior to the census - between 5 April 2009 and 4 April 2010.

Table 2: Reported (unadjusted) number of births during the one-year period before the census by age group of women and State, FSM: 2010

State	Age group	Number of women	Males	Females	Total	ASFR
FSM	15–19	5,750	101	87	188	0.033
	20–24	4,455	312	258	570	0.128
	25–29	3,805	347	297	644	0.169
	30–34	3,194	246	187	433	0.136
	35–39	3,019	171	124	295	0.098
	40–44	2,864	68	64	132	0.046
	45–49	2,549	13	6	19	0.007
	Total	**25,636**	**1,258**	**1,023**	**2,281**	**TFR = 3.1**
Yap	15–19	564	20	14	34	0.060
	20–24	415	35	28	63	0.152
	25–29	418	35	37	72	0.172
	30–34	411	22	23	45	0.109
	35–39	362	19	9	28	0.077
	40–44	375	5	9	14	0.037
	45–49	348	2	1	3	0.009
	Total	**2,893**	**138**	**121**	**259**	**TFR = 2.8**
Chuuk	15–19	2,827	39	34	73	0.026
	20–24	2,129	129	111	240	0.113
	25–29	1,808	152	131	283	0.157
	30–34	1,442	121	97	218	0.151
	35–39	1,362	79	75	154	0.113
	40–44	1,265	43	33	76	0.060
	45–49	1,144	9	3	12	0.010
	Total	**11,977**	**572**	**484**	**1,056**	**TFR = 3.0**
Pohnpei	15–19	1,999	36	33	69	0.035
	20–24	1,656	120	88	208	0.126
	25–29	1,368	136	106	242	0.177
	30–34	1,152	79	59	138	0.120
	35–39	1,116	58	29	87	0.078
	40–44	1,042	19	15	34	0.033
	45–49	898	1	1	2	0.002
	Total	**9,231**	**449**	**331**	**780**	**TFR = 2.7**
Kosrae	15–19	360	6	6	12	0.033
	20–24	255	28	31	59	0.231
	25–29	211	24	23	47	0.223
	30–34	189	24	8	32	0.169
	35–39	179	15	11	26	0.145
	40–44	182	1	7	8	0.044
	45–49	159	1	1	2	0.013
	Total	**1,535**	**99**	**87**	**186**	**TFR = 4.1**

Based on these data, the directly calculated Total Fertility Rate (TFR), the average number of children per woman, was 3.1; it was 2.8 in Yap, 3.0 in Chuuk, 2.7 in Pohnpei, and 4.1 in Kosrae (Fig.31).

Figure 31: Reported (unadjusted) Total Fertility Rate (TFR) by State, FSM: 1994, 2000, 2010
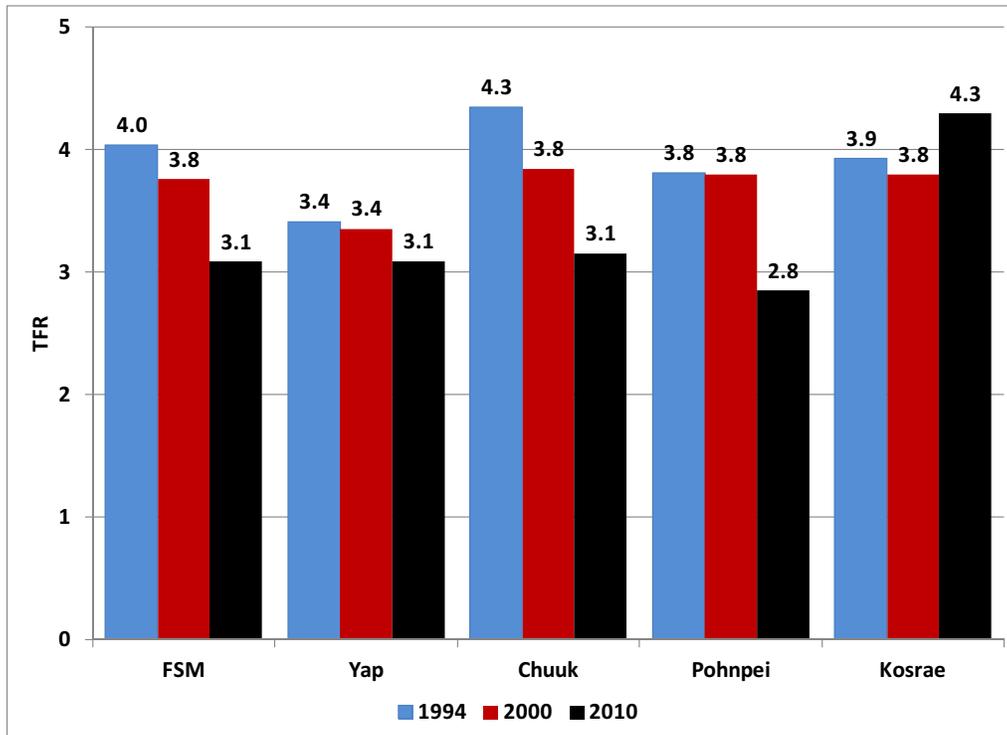
ASFR and TFR

The Age-Specific Fertility Rate (ASFR) is defined as the ratio of the number of live births occurring during a specified period to specified age or age group of women to the number of women in the same period and same age. Summation of the age-specific fertility rates multiplied by the age interval gives an age standardized index of fertility, referred to as the Total Fertility Rate (TFR).

The Total Fertility Rate is defined as the number of children that would be born per woman if all women were to live to the end of their childbearing years and would bear children according to the age-specific fertility pattern that prevailed at the time reference point or period of the TFR.

However, it needs to be pointed out that the reported number of births during the year before the census based on the question when a woman had her last child is lower than the corresponding population aged under 1 year of age (Table 3). It therefore can be concluded that the reporting of births suffers from underreporting, and the directly calculated Age Specific Fertility Rates (ASFR) and TFRs are certainly too low.

Based on a comparison of reported number of births and enumerated population aged less than 1 year of age it seems that the reporting of the number of births was better in Yap and Kosrae than in Chuuk and Pohnpei.

Table 3: Reported (unadjusted) number of births during the one-year period before the census, and enumerated population aged under 1 year of age by State, FSM: 2010

	FSM	Yap	Chuuk	Pohnpei	Kosrae
Reported number of births	2,281	259	1,056	780	186
Population aged < 1	2,511	267	1,177	874	193
Difference	230	8	121	94	7
Reported births as part of population aged < 1 (%)	91	97	90	89	96

Possible measurement errors of reported number of births

- Very young women (teenagers) do not report the birth of their child (social stigma)
- Unmarried women do not state the birth of their child (social stigma)
- Women whose child died shortly after birth do not mention the birth of the child
- Women who had multiple births (either twins or triplets), or had 2 births during the 12 month period before the census, only record 1 birth
- Women temporarily absent from their permanent household were counted, but their fertility status was not recorded, and/or wrongly assumed to be zero.
- Recall lapse: some older women tend to underreport the number of children who were born a long time ago and especially those who died during infancy are sometimes omitted. Furthermore, older women sometimes do not remember the exact date of birth of their last child.
- Errors during data recording/processing

A comparison of the reported (unadjusted) Age-Specific Fertility Rates (ASFR) for FSM and the 4 different States based on the last 3 censuses is shown in Figures 32-36. Again, as has been demonstrated before based on data on children ever born, the data show an apparent fertility decline, except for Kosrae.

Figure 32: Reported (unadjusted) Age-specific Fertility Rates (ASFR), FSM: 1994, 2000, 2010
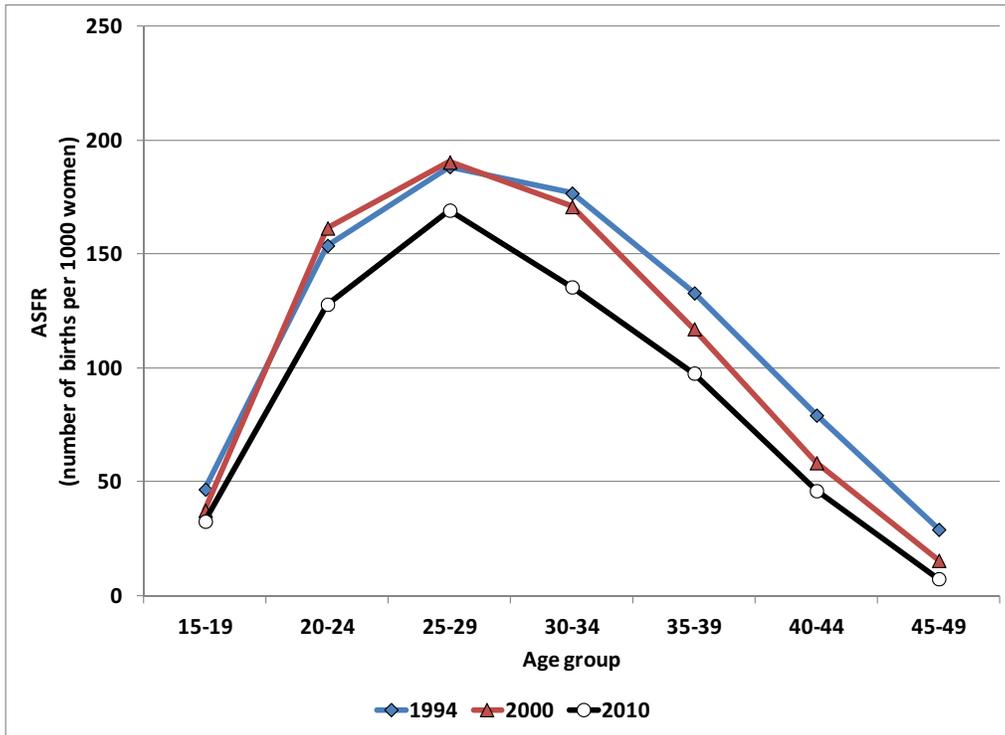
Figure 33: Reported (unadjusted) Age-specific Fertility Rates (ASFR), Yap: 1994, 2000, 2010
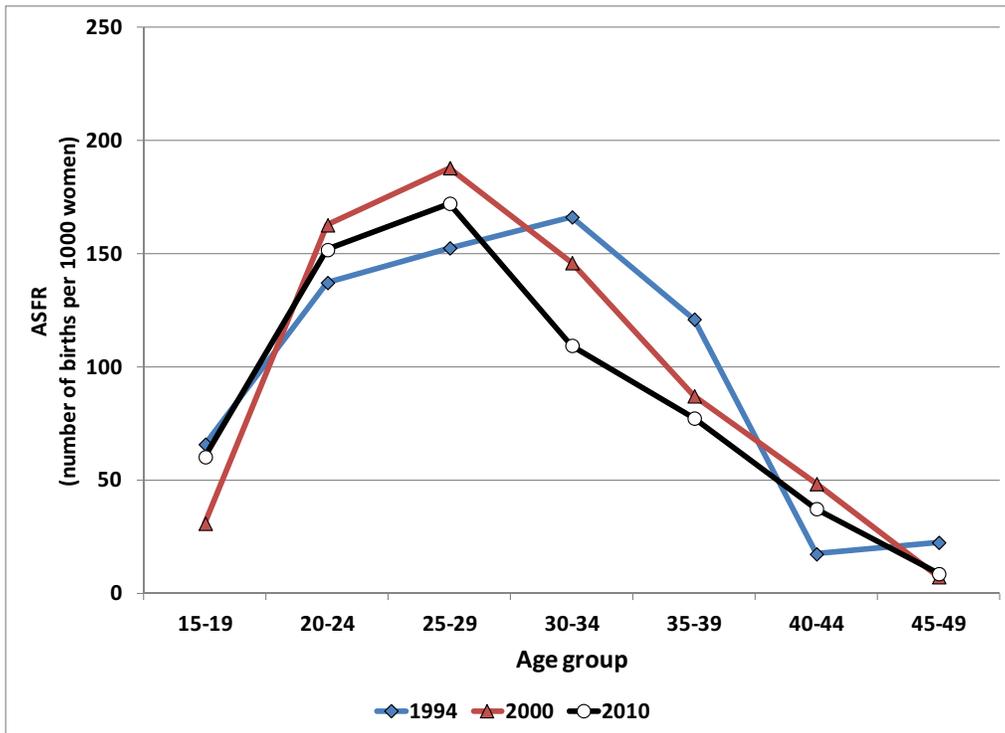
Figure 34: Reported (unadjusted) Age-specific Fertility Rates (ASFR), Chuuk: 1994, 2000, 2010
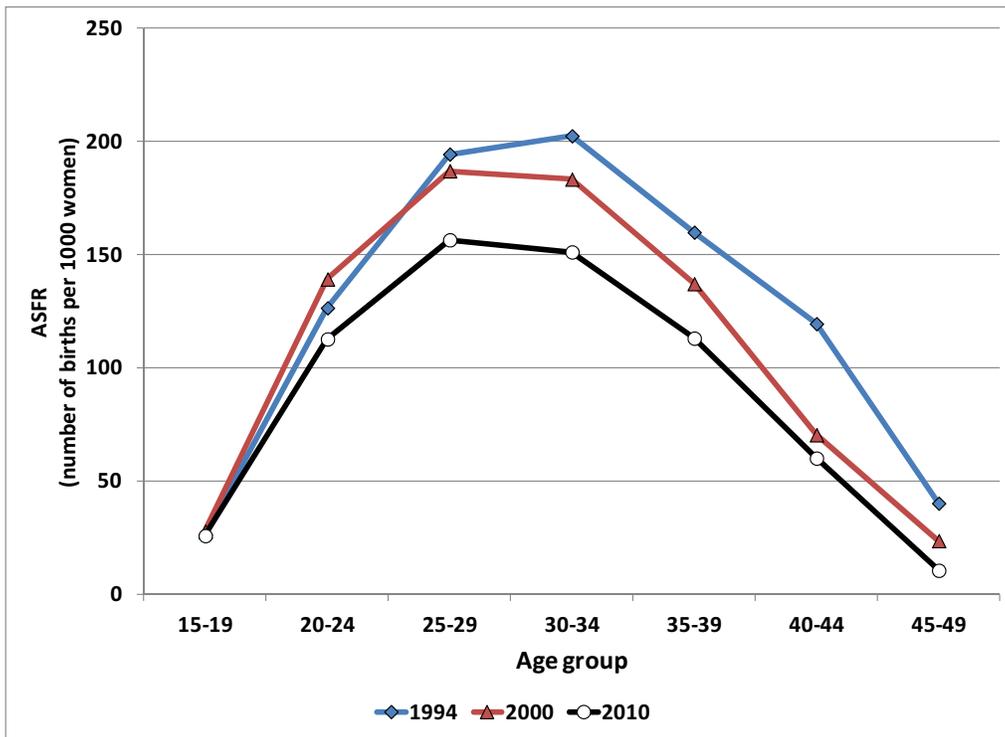
Figure 35: Reported (unadjusted) Age-specific Fertility Rates (ASFR), Pohnpei: 1994, 2000, 2010
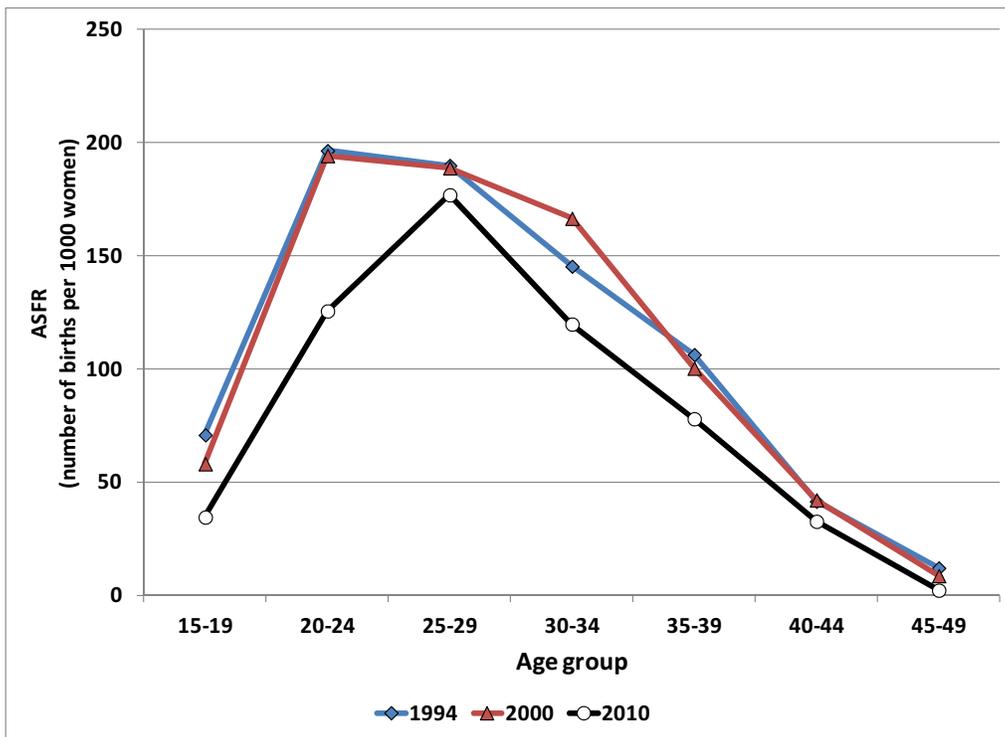
Figure 36: Reported (unadjusted) Age-specific Fertility Rates (ASFR), Kosrae: 1994, 2000, 2010
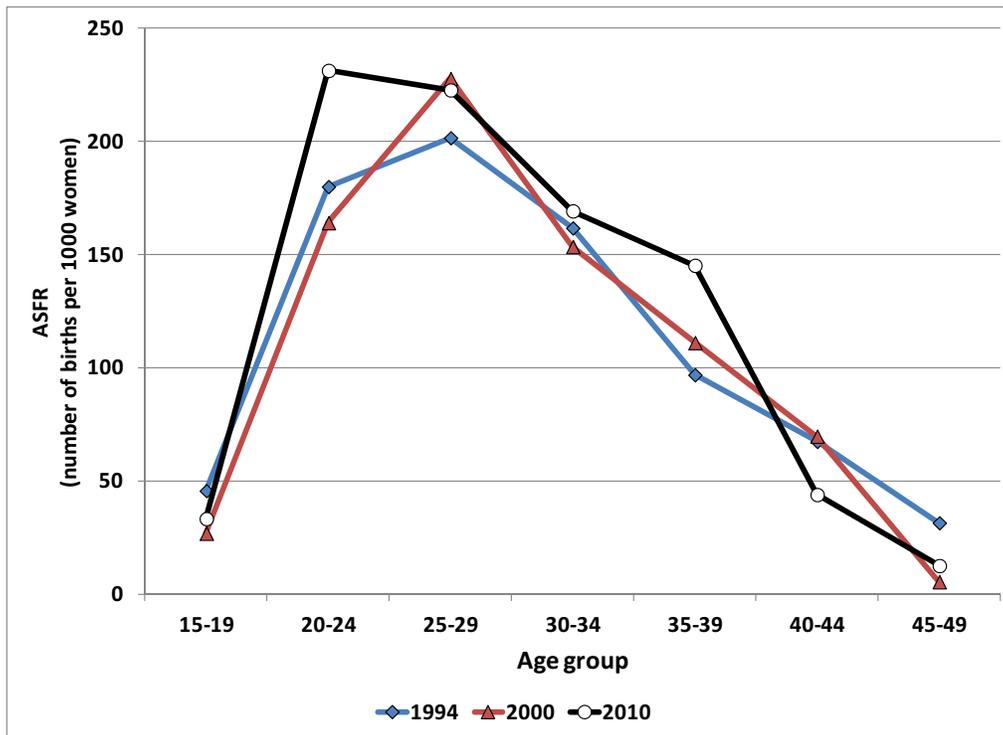
The adolescent fertility rate based on reported (unadjusted) number of births during 1-year period before the census was 33 in the FSM in 2010, meaning that there were 33 births per 1000 women aged 15-19 years. It was with 60 much higher in Yap, and was with 26 relatively low in Chuuk. The teenage fertility rate was 35 in Pohnpei, and 33 in Kosrae.

A comparison of the reported (unadjusted) Age-Specific Fertility Rates (ASFR) for FSM and the 4 different States based on the last 3 censuses pointes to a general fertility decline among teenage women, except for Yap and Kosrae.

However, as these indicators are based on unadjusted data, the fertility rates will be adjusted upwards using the appropriate methodologies as will be discussed later.

2.5 Sex ratio at birth

The sex ratio of birth is the number of male births per 100 female births. The sex ratio at birth based on the number of children ever born (number of lifetime live-births) was **108**; there were 108 male births per 100 female births, and at birth boys outnumber girls to an unusually high extent (Fig.37).

While this sex ratio is significantly higher than the 105 generally found around the world, it is considerably lower than the one based on the number of children born during the year before the census which was 123 for the total of the FSM (114 in Yap, 118 in Chuuk, 136 in Pohnpei, and 114 in Kosrae). This is turn compares to an implied sex ratio at birth of 107 based on the enumerated population aged less than 1 year of age.

One explanation is that this reported high ratio is caused by sex-specific recall errors. Apart from genuine recall errors related to accurate respondent memory, it is also possible that people are biased towards reporting sons rather than daughters. Even though some of the census data suggest otherwise, there is no apparent reason to believe that sex preference in reporting is a significant factor in the FSM.

At this point it should be noted that since many years research is being conducted whether or not parental Hepatitis B carrier status is associated with a higher offspring sex ratio (more boys)[2]. Nonetheless the conclusion drawn from the different studies is inconclusive.

In terms of differences in number of male-female births, the highest sex ratio at birth was recorded in Yap (110) followed by Chuuk (108), whereas lower than average sex ratios were calculated for Pohnpei (107) and especially for Kosrae (105).

Note that the sex ratio at birth based on the registered number of births for the years 2008-2010 was also 108.

Figure 37: Sex ratio at birth based on total number of children ever born (number of live-births) by State, FSM: 2010

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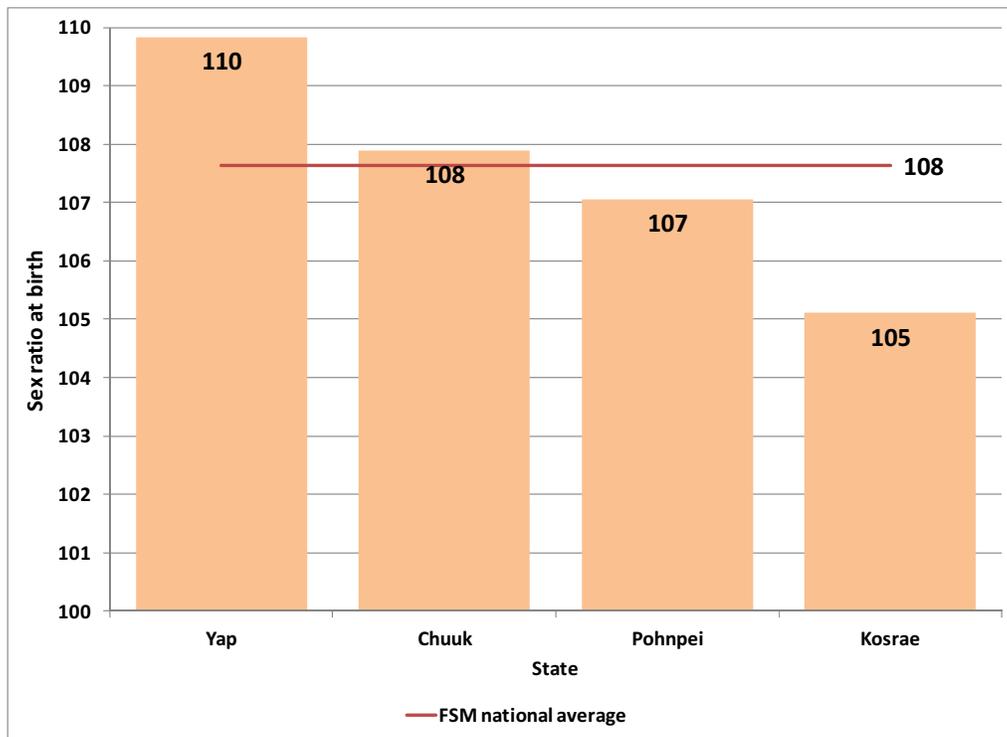
[2] G.Chen, E.Oster, X.Yu, W.Lin "Hepatitis B and Sex Ratios at Birth: Re-visiting the Relationship", 2008

3 Census information - indirect methods

3.1 Estimates based on own-children method

3.1.1 Introduction

The FSM census collected data on the relationship of mothers with their own children. This information allows application of the so-called 'Own-Children Method' to estimate fertility trends over the 15 years preceding the census, in this case for the period 1996-2010. In essence, the Own Children Method (OCM) results in Age-Specific and Total Fertility Rates for each of the 15 years preceding the census, based on the data for mothers matched with that of their biological children[3].

The Own Children Method of fertility estimation

The input data required for the application of the own-children technique is the single-year age distribution of the population under 16 years of age by age of their mothers. This is used to create a matrix of children under 16 years of age corresponding to their own mothers aged 15 to 64. This also provides data on the number of children under 16 years of age who are not matched with their mothers, giving the estimate of non-own children.

With this method, the age-specific fertility rates are estimated by reverse projection of the enumerated children to the time of their birth and the female population to each of the 15 years preceding the census in which the children were born.

For the purpose of the historic projection of enumerated children and female population from the 2010 FSM census, the life expectancy at birth estimated around the year 2010 has been used. The advantage of this method is that it does not depend upon any assumption about fertility trends and is not very sensitive to assumptions about recent changes in mortality (United Nations, 1983).

The sensitivity analysis carried out by Abassi-Shavazi (1997) using data from the 1991 census of Australia by place of birth has demonstrated that this method gives robust estimates of time trends in fertility under conditions of changing fertility and mortality during past years. Therefore, only one set of life expectancy at birth has been used in the reverse projection of the population and this is assumed to have remained constant during the period of study. As Stated by Abassi-Shavazi (1997), this method has only a small effect on the fertility estimates where non-own children constituted 25 to 30 percent of all children. In the present census, the percentage of non-own children is 25 percent.

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[3] The results of the own-children method were kindly prepared and provided by Mr. Michael Levin of the Harvard University Center for Population and Development Studies.

3.1.2 Total Fertility Rate

The detailed output of Age-specific and Total Fertility Rates for the period 1996 to 2010 is shown in Appendix 2 and 3, and summarized in Figure 38. As these numbers show yearly fluctuations in the estimated TFR, three-year averages of TFRs is presented in Figure 39 which results in a smoother trend of the TFRs.

In general the estimated TFRs reveal a consistent trend of declining fertility from the late-1990s to the present, and show an average reduction of the TFR of about 1 child during the period 1996-2010. It decreased from about 4.6 for the years 1996-1998 to 3.5 for the years 2008-2010 when the TFR was lowest in Yap (3.0), and highest in Kosrae (4.1). The average number of children per woman (TFR) was 3.8 in Chuuk and 3.3 in Pohnpei. While the fertility level for Yap and Pohnpei has consistently been lower than that of Chuuk and Kosrae, the overall timing and pace of fertility decline seem to have been very similar among the different FSM States.

In comparison to other Pacific Islands countries and territories (PICT), the level of TFR of the FSM ranks about right in the middle of countries around the region. Nonetheless, there are many countries with much lower TFRs and have therefore progressed much further in terms of their fertility transition from high to low fertility rates (Fig.40).

It is to be noted that the TFR estimated from the own-children method are almost identical with the TFR obtained from the application of other *Indirect methods* such as Trussell P/F Ratio Technique[i], the Arriaga Method[ii] (using 1 point in time), and/or the Relational Gompertz method[iii], especially for the year 2000 (Table 4 and Appendices 4-9). While for the year 2010 the own-children method produces slightly higher estimates compared to the other indirect methods, it is important to know that the other indirect methods produce implausible low rates for Yap and Kosrae when applying the methods to data for each State separately, and the estimated fertility levels result in far lower values than those directly calculated based on the reported number of births during the year before the census. On the other hand, the *Direct methods* produce much lower fertility estimates than the *Indirect methods* because the reported numbers of births from the census, as well as the registered numbers of births suffer from underreporting.

This report will rely on results calculated by the application of the *own-children method* for three reasons:

1. It produces more plausible results for the FSM State levels than the other indirect methods;
2. It produces a detailed annual trend analysis for the 15-year period before the census;
3. It produces consistent and comparable results for the different geographic areas and socio-economic sub-groups.

Table 4: Comparison of TFR estimates derived by various methods, FSM: 1994, 2000 and 2010

Census year	Direct methods		Indirect methods				
	Reported number of births during 1 year before census	Vital statistics	Own-children method	Arriaga Method, using 1 point in time	Arriaga Method, using 2 points in time	Trussell P/F Ratio Technique	Relational Gompertz method
1994	4.0			5.3	4.9	5.0	5.2
2000	3.8	3.2	4.4	4.4	3.8	4.4	4.8
2010	3.1	2.7	3.5	3.3	2.9	3.4	3.4

Figure 38: Total Fertility Rate (TFR) based on Own-Children method by State – single years, FSM: 1996-2010
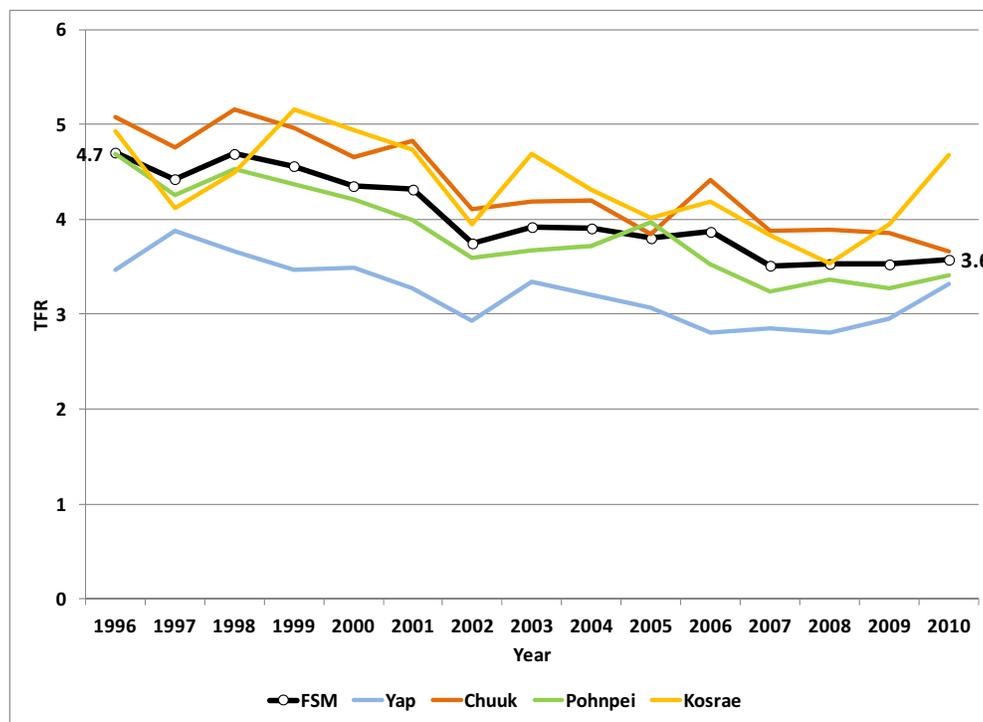
Source: Michael Levin, Harvard University Center for Population and Development Studies

Figure 39: Total Fertility Rate (TFR) based on Own-Children method by State - 3-year average, FSM: 1996-2010
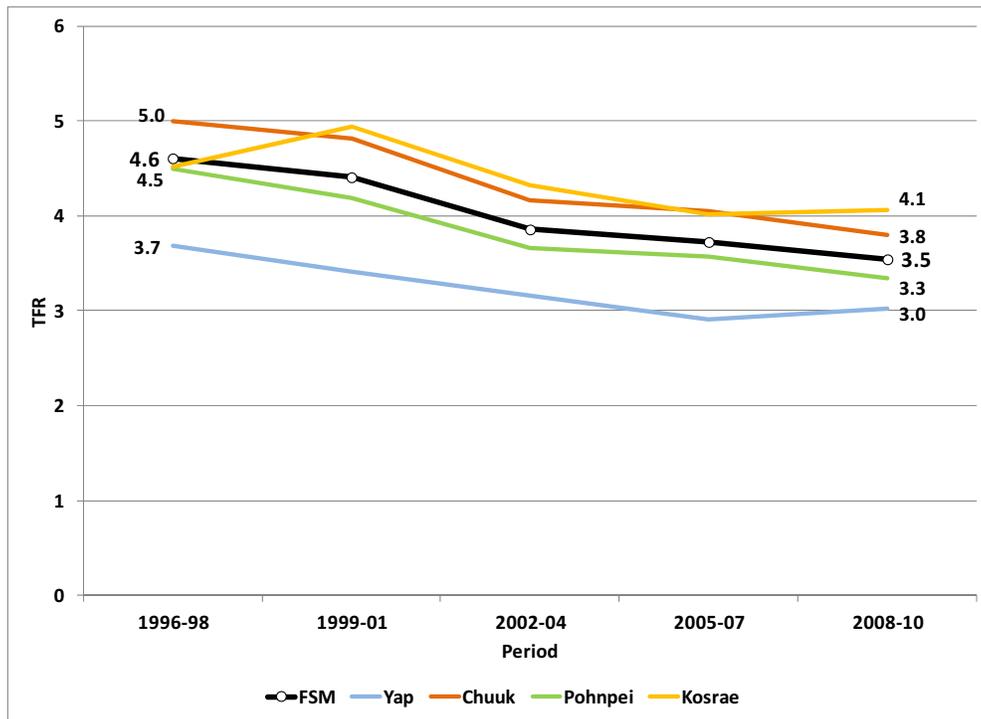
Source: Michael Levin, Harvard University Center for Population and Development Studies

Figure 40: Total Fertility Rate (TFR), PICT: latest available year
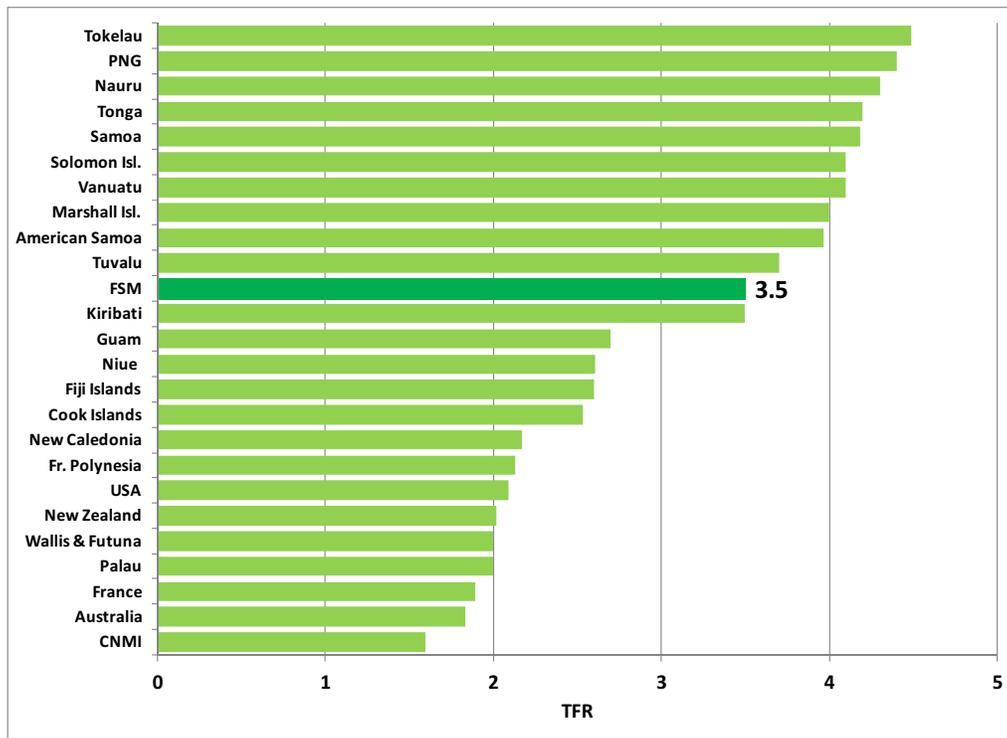
3.1.3 Age-Specific Fertility Rates

Figures 41-45 present the age pattern of fertility for the 3 different periods 1996-1998, 2002-2004, and 2008-2010. It is apparent that during the period 1996-1998 and 2002-2004 a more pronounced fertility decline occurred than during the more recent periods 2002-2004 and 2008-2010. In the two earlier periods the fertility decline was most evident among age groups 20-34 years, whereas during the two more recent periods the fertility decline was more obvious for age groups 15-24 years.

Even though the most fertile age group of women remained the 24-29 year olds, their fertility declined from 221 to 177 births per 1000 women. However, in relative terms the decrease of fertility levels of the 20-24 year olds was most pronounced as it declined from 199 to 136 births per 1000 women.

Although in general the pace of fertility decline among States was very similar, it needs to be noted that the fertility decline in Pohnpei was mainly driven by the young women aged 15-24 years (Fig.44).

Regarding most current fertility levels by age the fertility levels of the 15-19 year olds were almost identical among the different States, and there were only minor differences among the 20-24 year old women. The differences in fertility levels by State are really only significant for women aged 25 years and older; while the 25-29 year old Kosraean women had much higher fertility levels than women in all the other States. The most diverse fertility levels were found among women aged 30-39 years. At these ages Pohnpeian and Yapese women had significantly lower levels of fertility levels than women from Chuuk and Kosrae (Fig.46)

Figure 41: Age-specific Fertility Rates, FSM: 1996-2010
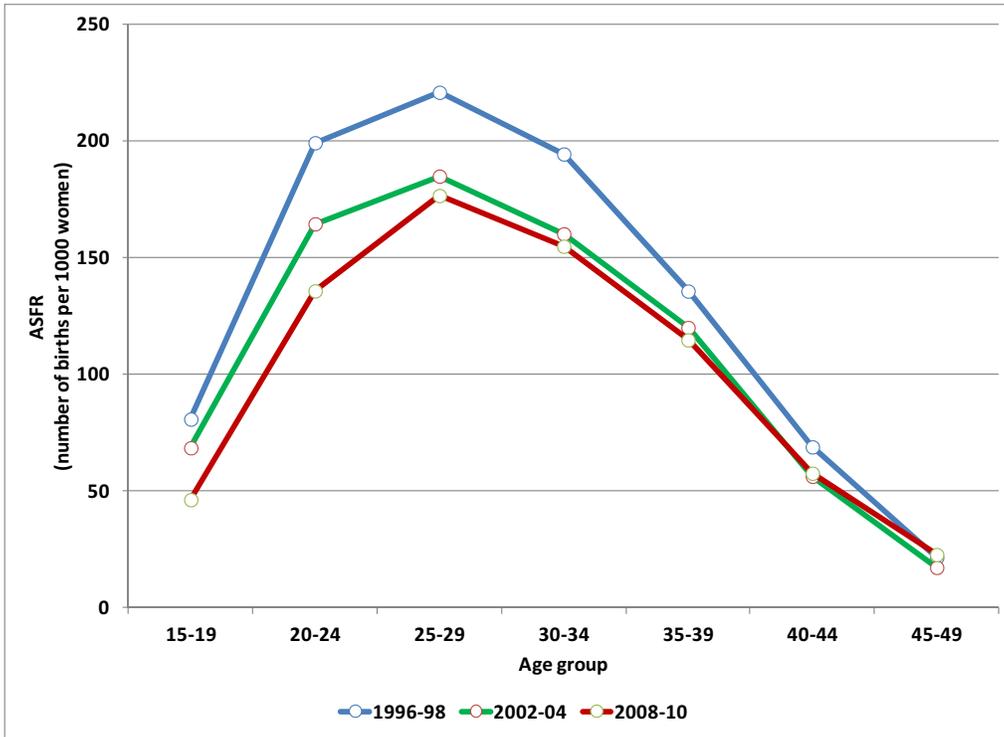
Source: Michael Levin, Harvard University Center for Population and Development Studies

Figure 42: Age-specific Fertility Rates, Yap: 1996-2010
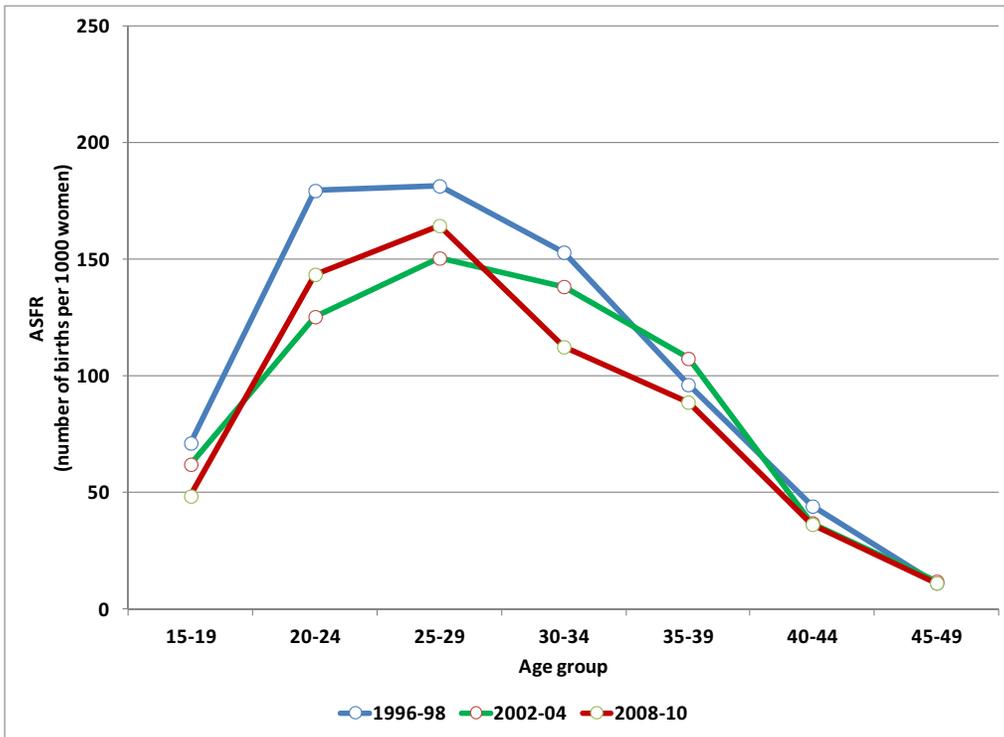
Source: Michael Levin, Harvard University Center for Population and Development Studies

Figure 43: Age-specific Fertility Rates, Chuuk: 1996-2010

Source: Michael Levin, Harvard University Center for Population and Development Studies

Figure 44: Age-specific Fertility Rates, Pohnpei: 1996-2010

Source: Michael Levin, Harvard University Center for Population and Development Studies

Figure 45: Age-specific Fertility Rates, Kosrae: 1996-2010

Source: Michael Levin, Harvard University Center for Population and Development Studies

Figure 46: Age-specific Fertility Rates by State, FSM: 2008-2010

Source: Michael Levin, Harvard University Center for Population and Development Studies

3.1.4 Adolescent Fertility Rate

The adolescent fertility rate (ages 15-19) is highly useful in the planning of reproductive health services to improve the health and well-being of adolescent mothers and their children. Motherhood at a very young age entails a risk of maternal mortality that far exceeds the average, and the children of young mothers tend to have higher levels of morbidity and mortality. Because adolescents are physiologically and socially immature, health risks associated with their pregnancies and childbearing tend to be more pronounced than are those among older women. Adolescent women also face increased risks during pregnancy and childbirth because they tend to have less information and access to prenatal, delivery and postpartum care as compared with older women.

Figure 47: Adolescent Fertility Rates by State, FSM: 1996-2010
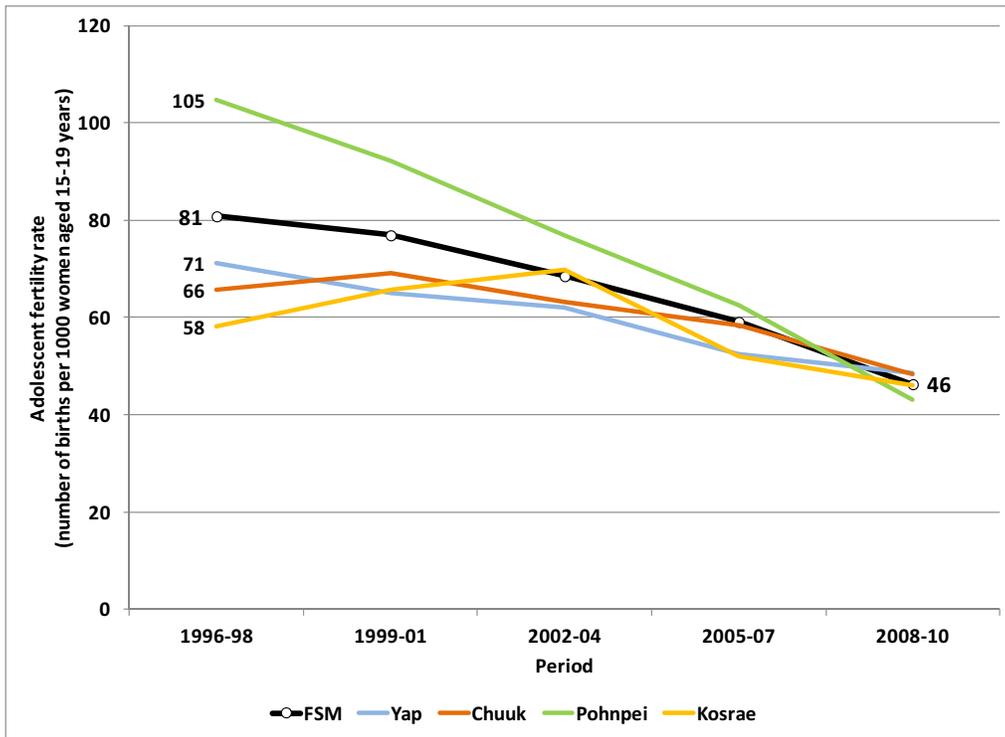
Source: Michael Levin, Harvard University Center for Population and Development Studies

Data presented in Figure 47 and Appendix 10 show that there has been a continuous decline in adolescent fertility among women in all States during the period 1996-2010, and it is interesting to see that the adolescent fertility rate of the different States converge to the same level of about 46 births per 1000 women in 2010. In 1996, Pohnpeian women had a much higher adolescent fertility rate (105 per 1,000 women) compared to women of all other States. While this overall development of declining adolescent fertility rates is certainly commendable, much needs to be done to bring it further down as the FSM still ranks in the upper half of countries with high adolescent fertility rates (Fig.48).

Figure 48: Adolescent Fertility Rates, PICT: latest available year
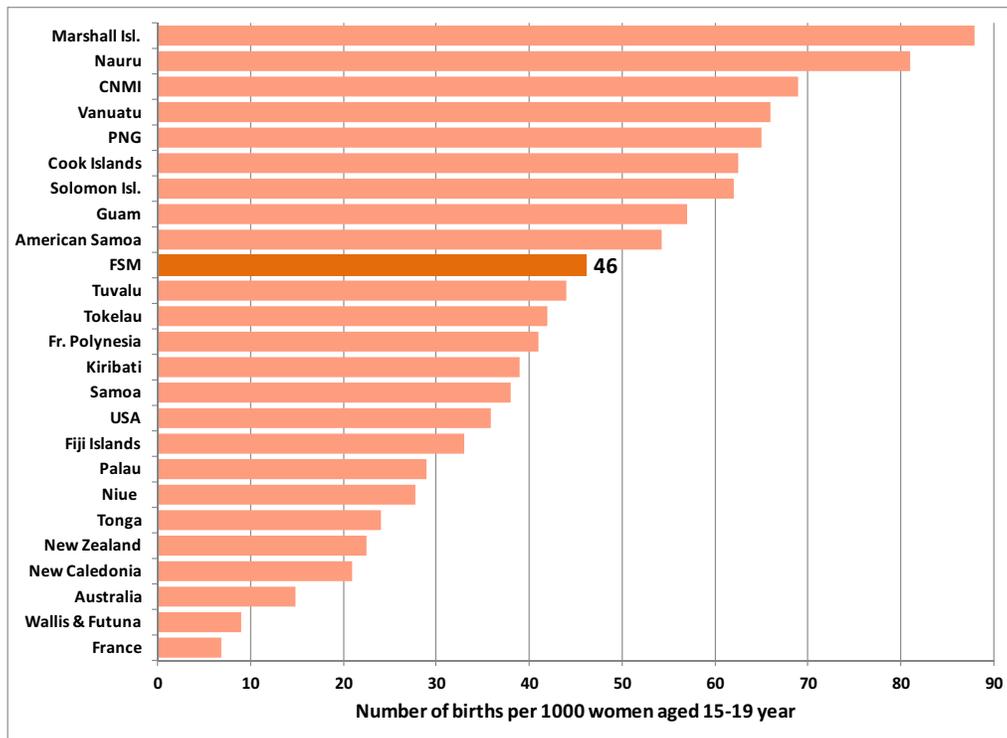
3.1.5 Mean age at childbearing

The mean age at childbearing (MAC) is the mean age of mothers at the birth of their children. It is computed as the sum of age-specific fertility rates weighted by the mid-point of each age group, divided by the sum of the age-specific rates. Overall, the average age at childbearing increased slightly for all States of the FSM, and it increased from 29.7 years to 30.5 years (Fig.49).

The increase in MAC during the period 1996 to 2010 is directly linked to the change in fertility pattern as described above. It was shown that it was foremost a decrease of fertility of younger women that contributed to the overall decrease in fertility levels in FSM, which means that the relative contribution of older women to the overall fertility level increased, which in turn results in an increase of the mean age at childbearing.

Figure 49: Mean age at childbearing by State, FSM: 1996-2010
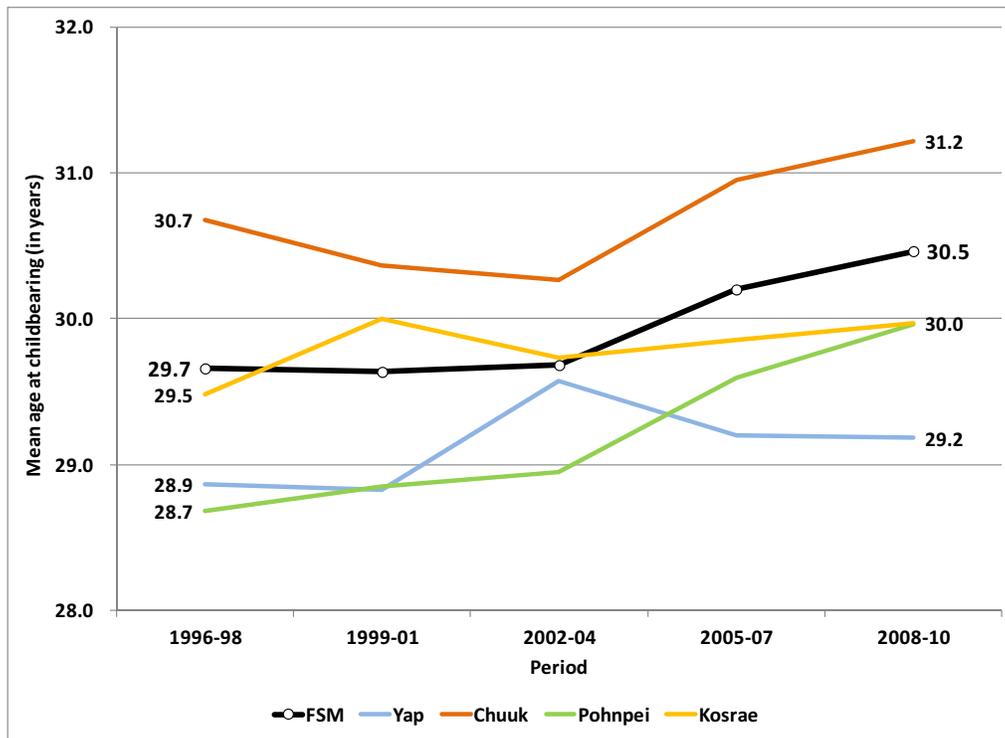
Source: Michael Levin, Harvard University Center for Population and Development Studies

3.1.6 Crude Birth Rate and natural growth

The Crude Birth Rate is the most basic indicator of fertility. It relates the total number of births in a given year to the total population during that year.

CBR

The Crude Birth Rate (CBR) is defined as the ratio between the total number of live births to a given population during a specified time period and the mid-year total population during the same period. This ratio multiplied by 1,000 represents the conventional way of expressing the Crude Birth Rate per 1,000 population.

Table 5 presents the estimated Crude Birth Rate (CBR), Crude Death Rate (CDR), and Migration rate for the period 2000-2010.

The vital rates have been calculated by preparing a population projection starting in the year 2000 using the 2000 census age and sex structure as the base population, and aiming at matching the 2010 population by age and sex. This has been achieved by applying the **balancing equation** to the intercensal 2000–2010 population growth:

Population growth = **Births** minus **Deaths** plus **Net migration**

Net migration can be estimated as

Net migration = **Population growth** minus **Births** plus **Deaths**

44

From the total population count of the 2000 census (107,008) and the 2010 census (102,843) the overall population growth of the intercensal periods can be calculated (Table 5). Since the birth rates are known based on estimates derived using the own-children method, and death rates are derived from estimated life expectancies at birth from data on children ever born and still alive, the overall net migration rates by age and sex could be calculated.

During the 10-year intercensal period the population decreased by 4,165 people. There were an estimated 28,704 births, 5,710 deaths, and -27,160 net migrants, meaning that 27,160 more people had left the FSM than had arrived during the intercensal period 2000-2010. This was an estimated -14,110 males and -13,050 females.

These numbers translate to an average CBR of 27.4 for the period 2000-2010, a CDR of 5.4 and a net migration rate of -25.9 per 1000.

The **natural growth rate** is the difference between the CBR and CDR and was 22 per 1000, or 2.2% per year. This means that if there had been no migration, the population of the FSM would have grown by about 2,300 people per year during the period 2000-2010, and would be about 130,000 people in 2010.

As was demonstrated before, the FSM has witnessed a sustained decline in fertility during the period 2000-2010 resulting in a declining CBR from about 32.3 in 2000 to 25.4 in 2010. It is to be noted that the CBR is affected by changes in age structure of the population under study and is therefore merely a rough indicator for fertility levels and trends.

Table 5: Vital statistics, FSM: 2000-2010

| Year | Population size | Vital statistics | | | | | | | | Population growth rate (%) |
| | | period | Number | | | | Rate (‰) | | | |
			Births	Deaths	Net migrants	Population growth	CBR	CDR	Net migration	
2000	**107,008**	2000 - 2001	3,455	664	-2,716	75	32.3	6.2	-25.4	0.07
2001	107,083	2001 - 2002	2,875	626	-2,716	-467	26.9	5.9	-25.4	-0.44
2002	106,616	2002 - 2003	3,020	609	-2,716	-305	28.4	5.7	-25.5	-0.29
2003	106,311	2003 - 2004	2,997	592	-2,716	-311	28.2	5.6	-25.6	-0.29
2004	106,000	2004 - 2005	2,902	575	-2,716	-389	27.4	5.4	-25.7	-0.37
2005	105,611	2005 - 2006	2,950	562	-2,716	-327	28.0	5.3	-25.8	-0.31
2006	105,284	2006 - 2007	2,629	540	-2,716	-627	25.0	5.1	-25.9	-0.60
2007	104,656	2007 - 2008	2,635	526	-2,716	-607	25.3	5.0	-26.0	-0.58
2008	104,049	2008 - 2009	2,623	514	-2,716	-606	25.3	5.0	-26.2	-0.58
2009	103,443	2009 - 2010	2,617	502	-2,716	-601	25.4	4.9	-26.3	-0.58
2010	**102,843**									
		2000 - 2010	**28,704**	**5,710**	**-27,160**	**-4,165**	**27.4**	**5.4**	**-25.9**	**-0.40**

3.1.7 Fertility rates by socio-economic background characteristics

Using current estimates of fertility, this section examines fertility differentials by religious denomination, woman's education, employment status, urban-rural residence, and marital status.

3.1.7.1 Religious affiliation

Data have been disaggregated by religious affiliation, and it shows that there was no significant difference in fertility levels. Note that only the two largest religious denominations were used as all other denominations were too small to show meaningful results.

While Catholic women had a slightly lower TFR of 3.5 in 2008-2010 than their Protestant counterparts (3.7), it probably is due to random annual fluctuations rather than a real difference in fertility levels (Figs.50-51).

Figure 50: Total Fertility Rate (TFR) by religious affiliation of women, FSM: 1996-2010
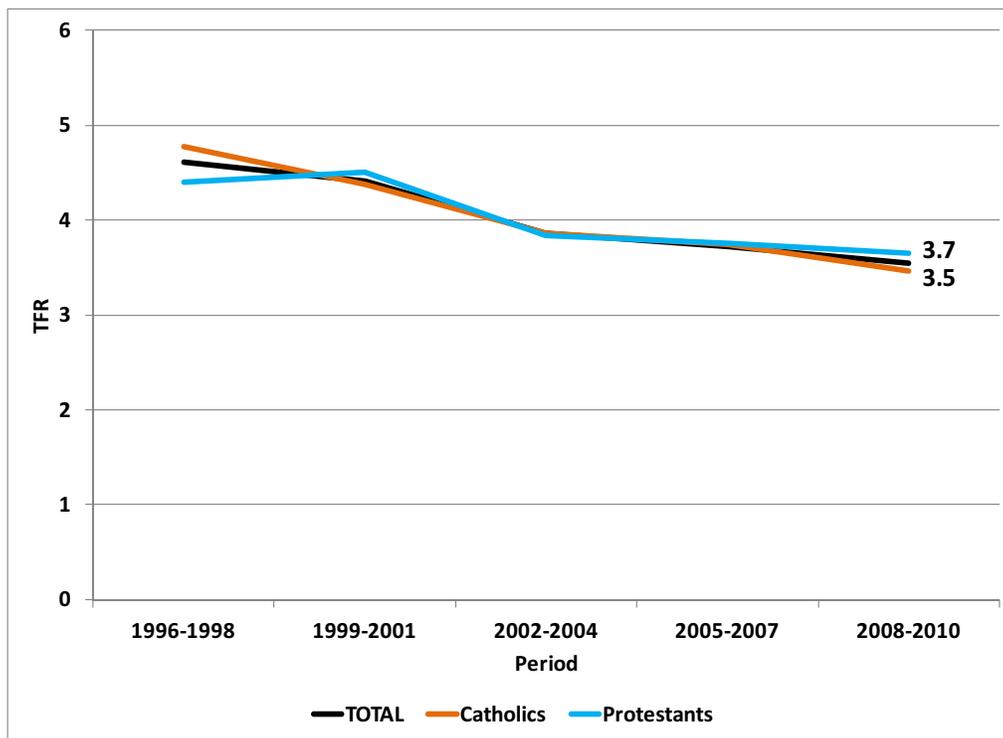
Source: Michael Levin, Harvard University Center for Population and Development Studies

Figure 51: Age-specific Fertility Rates by religious affiliation of women, FSM: 2008-2010
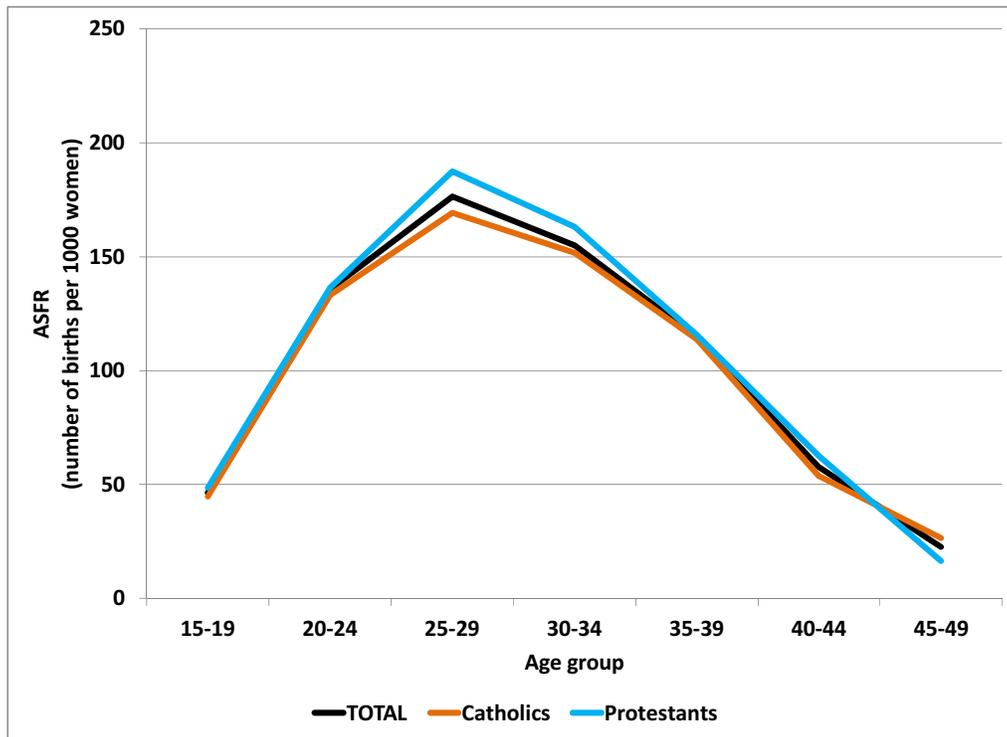
Source: Michael Levin, Harvard University Center for Population and Development Studies

3.1.7.2 Educational level

Differentials in fertility by education of women are presented in Figures 52-53. As expected, women with higher educational levels have lower fertility. High school graduates and women with tertiary education had significantly lower number of children than women who did not graduated and had completed grades 12 or less. The difference in fertility levels was most pronounced among women aged 20-34 years.

This result clearly proves the impact of education on fertility: the higher the level of education, the lower the level of fertility.

Figure 52: Total Fertility Rate (TFR) by educational level of women, FSM: 1996-2010
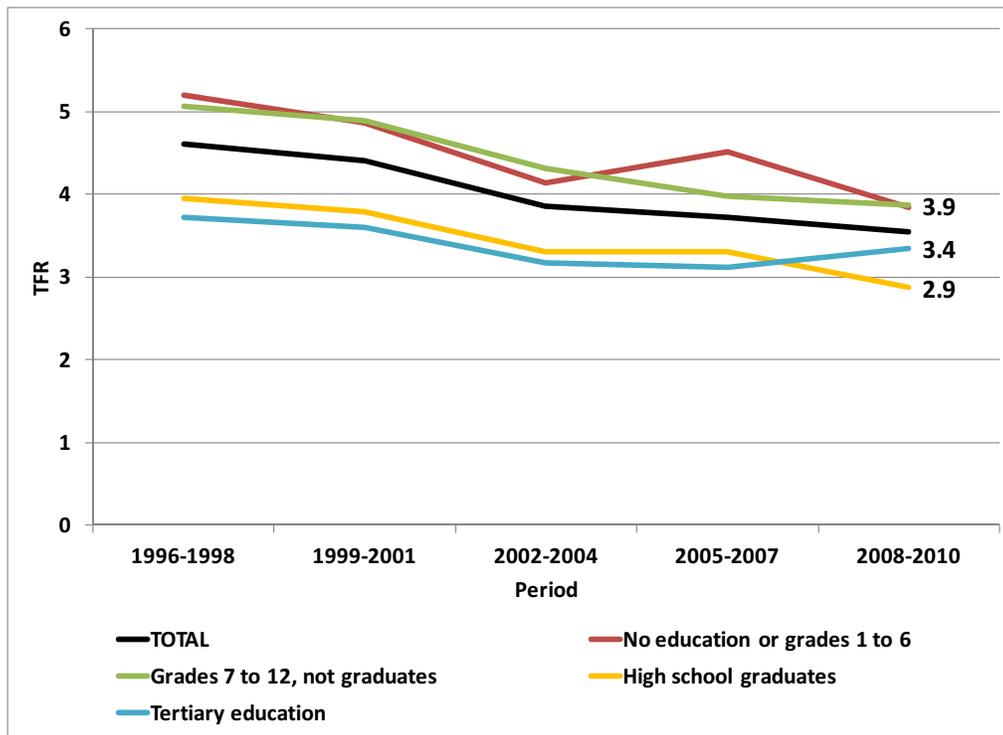
Source: Michael Levin, Harvard University Center for Population and Development Studies

Figure 53: Age-specific Fertility Rates by educational level of women, FSM: 2008-2010
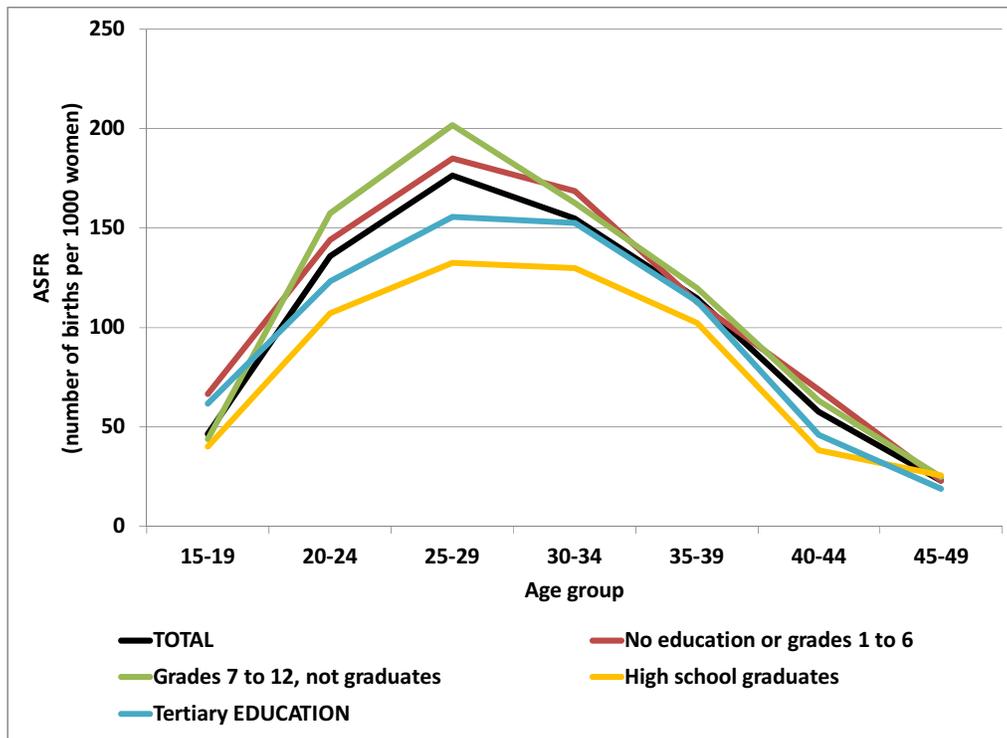
Source: Michael Levin, Harvard University Center for Population and Development Studies

3.1.7.3 Employment status

In terms of employment status, the census shows that employed women working for pay showed significantly lower levels of fertility than women who did subsistence work only or were not in the labor force. The difference in the average number of children between these two groups of women is exactly 1 child on average (Figs.54-55). Again, the difference in fertility levels was most noticeable among women aged 20-34 years.

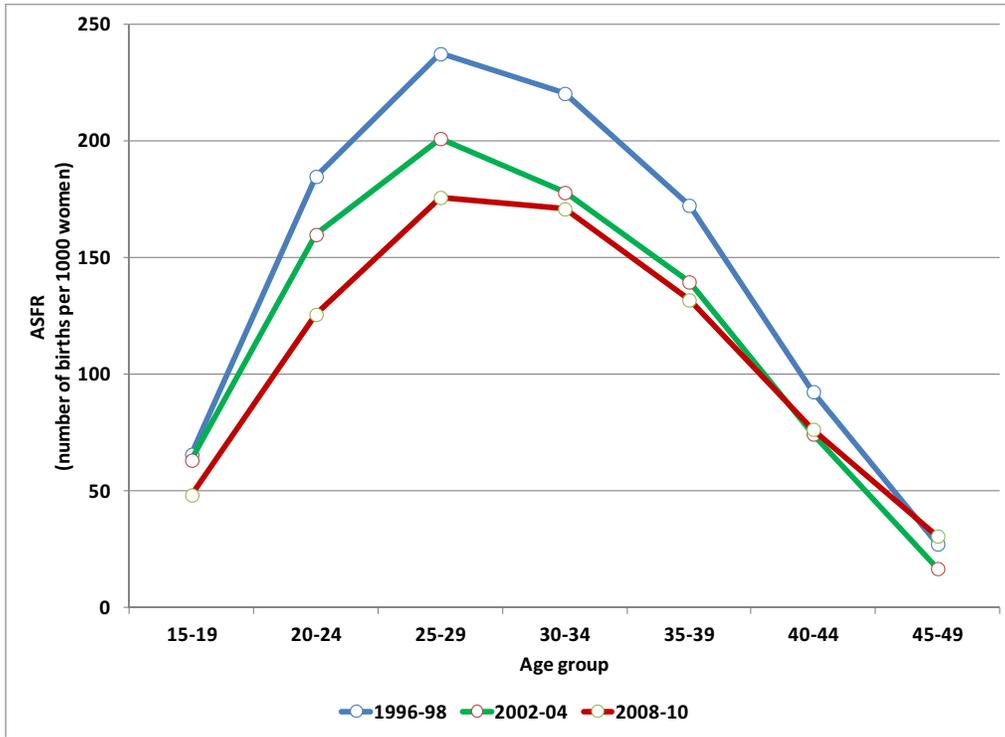**Figure 54: Total Fertility Rate (TFR) by employment status of women, FSM: 1996-2010**
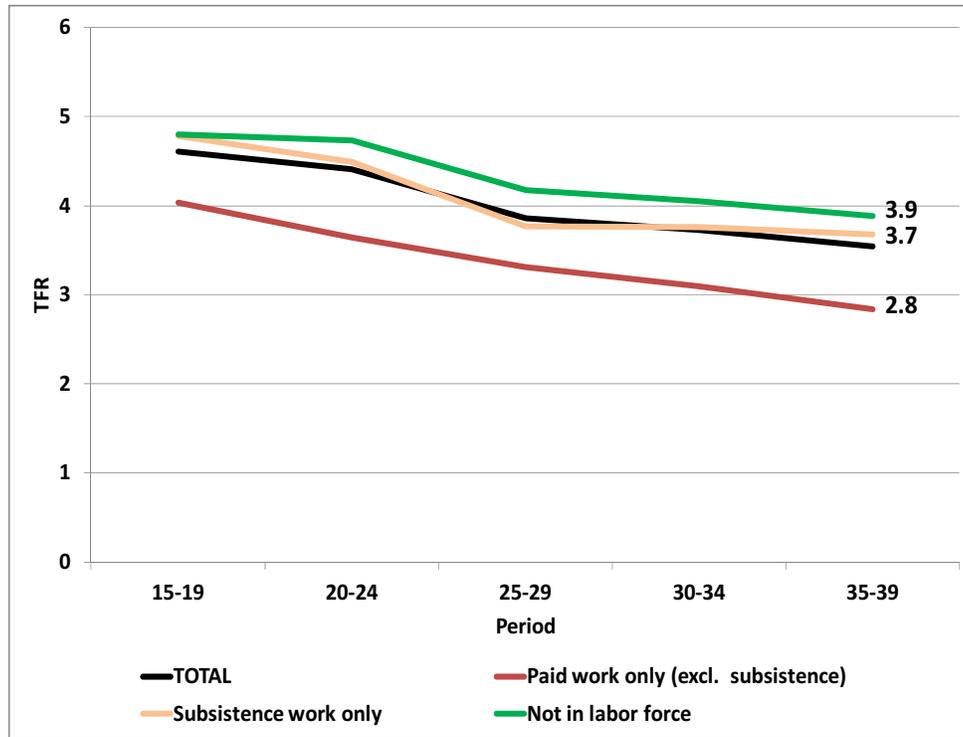
Source: Michael Levin, Harvard University Center for Population and Development Studies
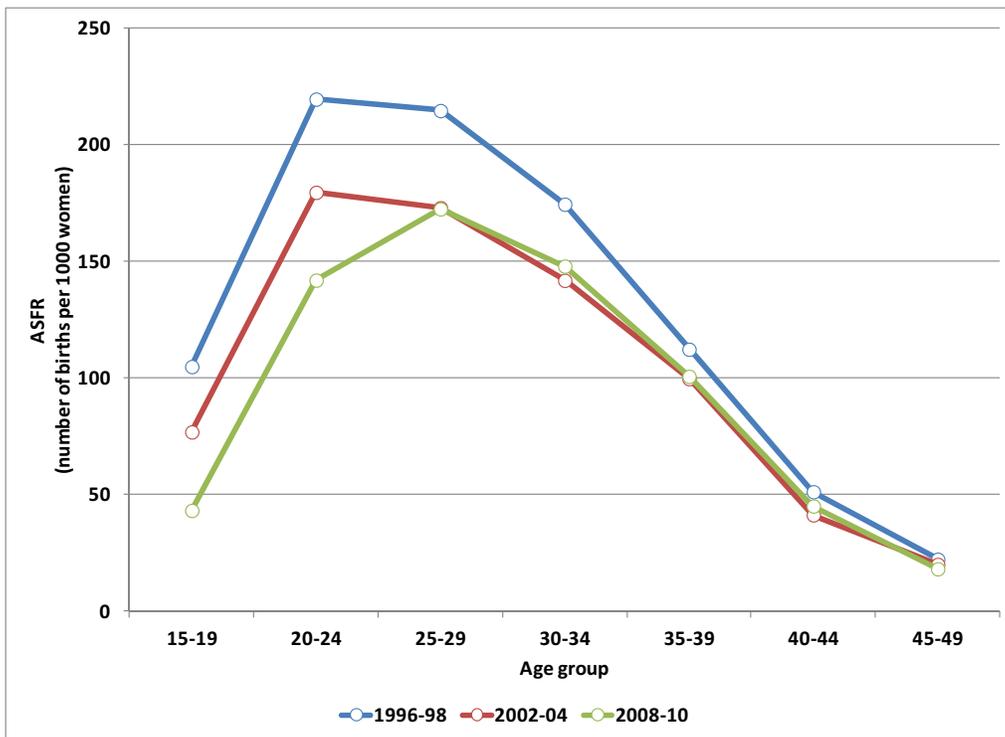
Figure 55: Age-specific Fertility Rates by employment status of women, FSM: 2008-2010
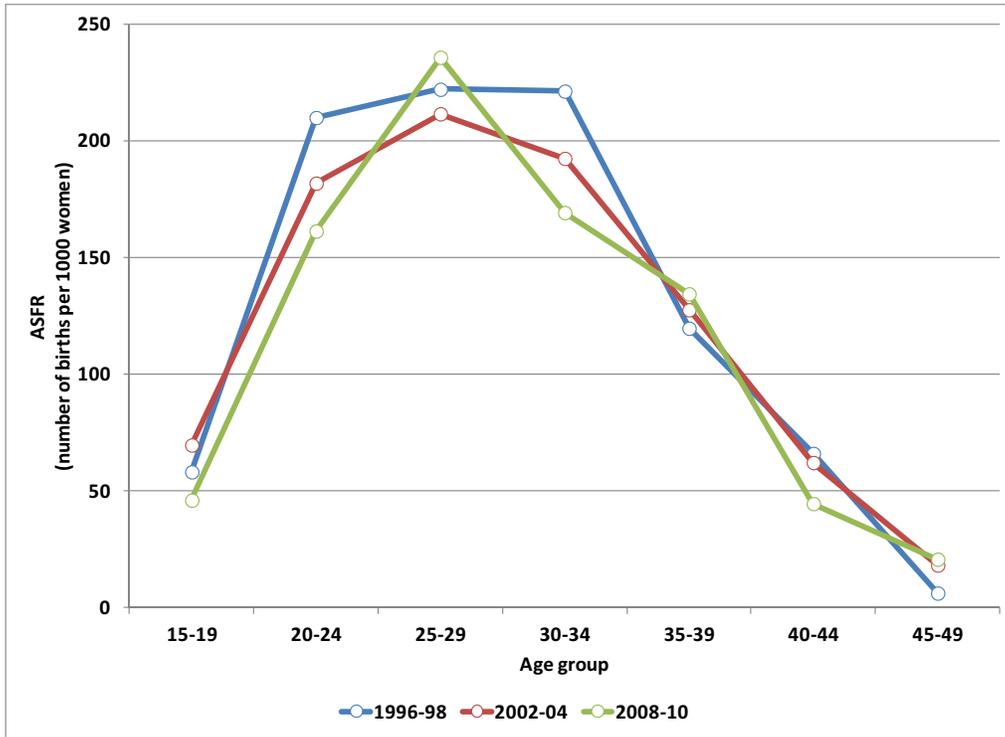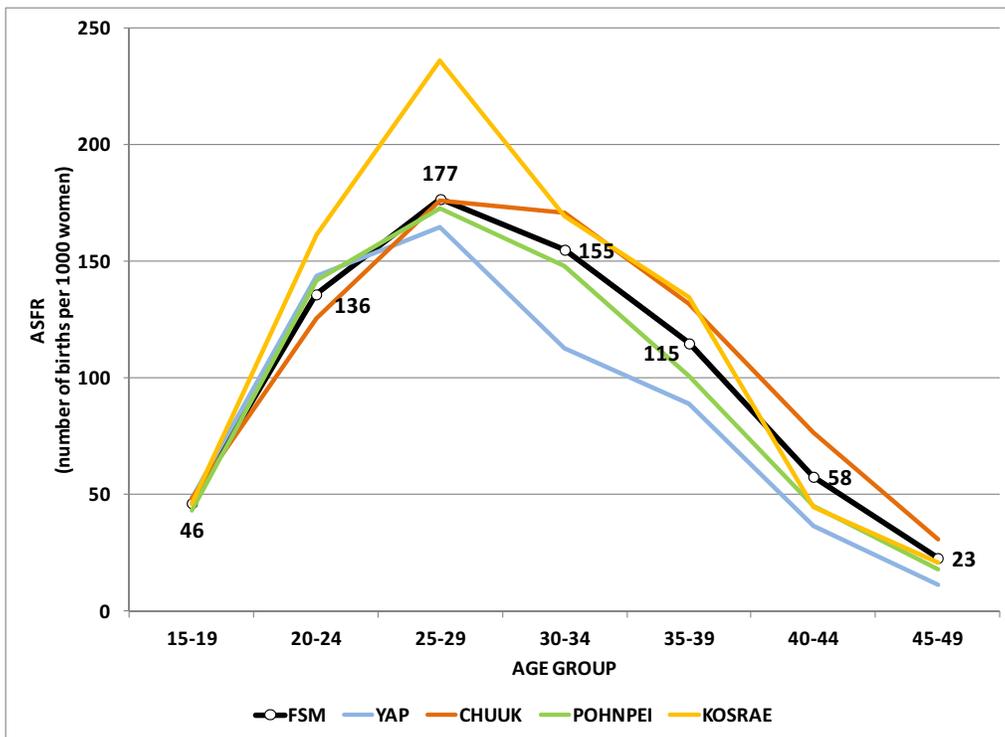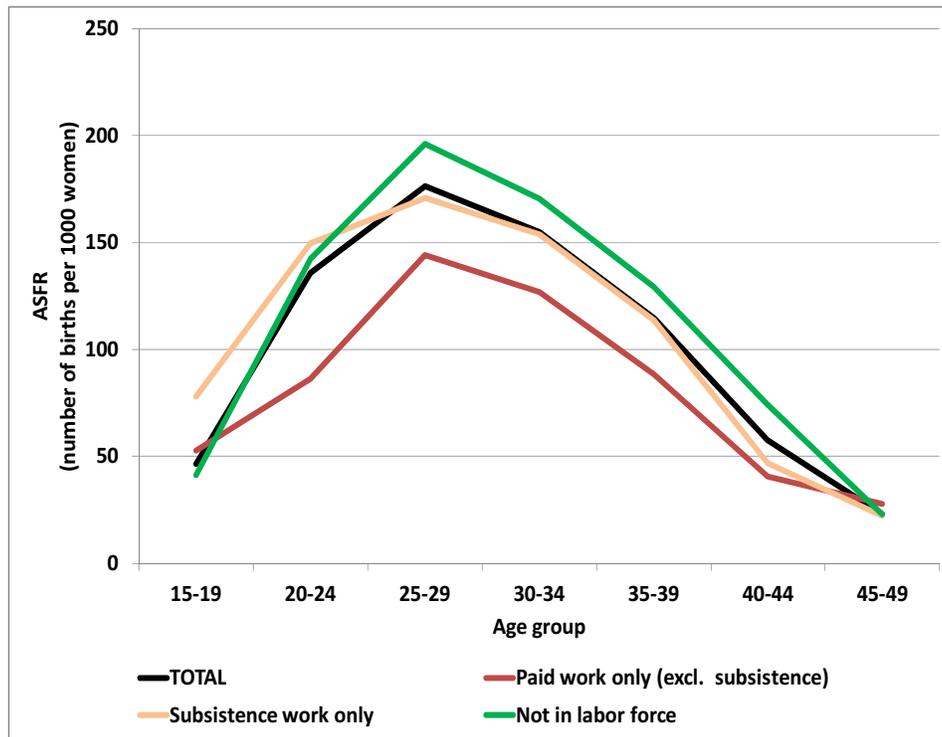

Source: Michael Levin, Harvard University Center for Population and Development Studies

3.1.7.4 Urban-rural residence

Surprisingly there was only a very small difference in fertility levels by urban-rural residence. While women living in urban areas had a TFR of 3.4, women in rural areas had a TFR of 3.6. Representatives of the Ministry of Health suggested that this can be explained by the strong presence of family and reproductive health personnel in rural areas. However, there was a noticeable difference in fertility levels of women aged 15-24 years and 30-34 years when urban women had lower fertility rates than their rural counterparts (Figs.56-57)

Figure 56: Total Fertility Rate (TFR) by urban-rural residence, FSM: 2008-2010
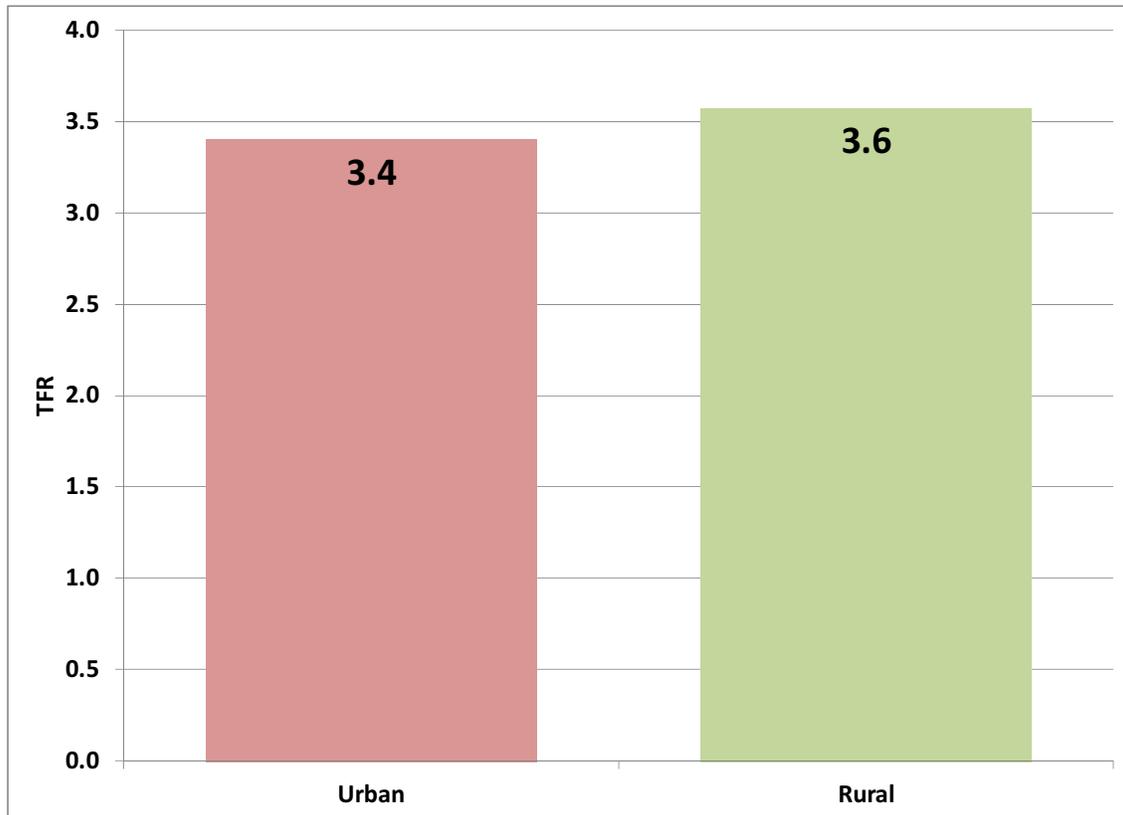
Figure 57: Age-specific Fertility Rates by urban-rural residence, FSM: 2008-2010
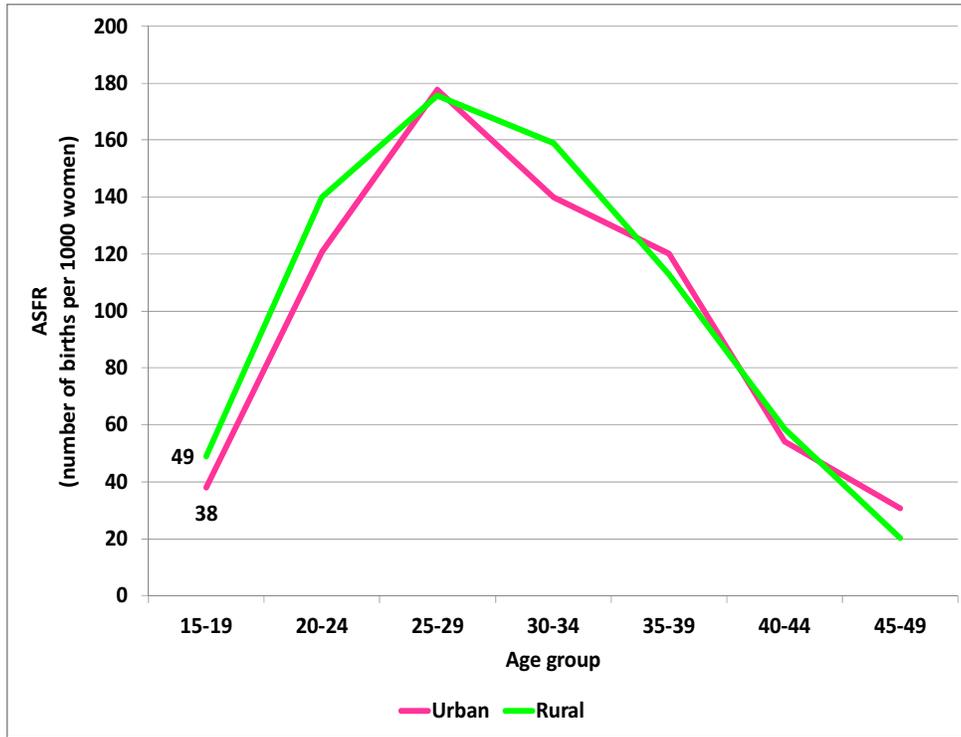
3.1.7.5 Marital status

As expected, marital fertility rates were much higher than that of women who never married. Out of the total number of reported children born to women aged 15-49 years, 92% were born to ever married women, and 81% of children born during the year before the census were born to ever married women (Table 6).

Table 6: Number of women by marital status and total number of lifetime live-births, and number of children born during 12 months before the census, FSM: 2010

Age group	Number of women			Total number of children ever born			Number of children born during 12 months before the census		
	Total	Ever married	Never married	Total	Ever married	Never married	Total	Ever married	Never married
15 - 19	5,750	480	5,270	392	213	179	188	99	89
20 - 24	4,455	1,648	2,807	2,529	1,842	687	570	402	168
25 - 29	3,805	2,379	1,426	5,309	4,509	800	644	537	107
30 - 34	3,194	2,506	688	7,268	6,630	638	433	395	38
35 - 39	3,019	2,552	467	8,993	8,508	485	295	281	14
40 - 44	2,864	2,539	325	10,658	10,249	409	132	128	4
45 - 49	2,549	2,326	223	10,784	10,483	301	19	17	2
Total	**25,636**	**14,430**	**11,206**	**45,933**	**42,434**	**3,499**	**2,281**	**1,859**	**422**

Estimated Age-specific fertility rates and Total fertility rates (TFR) based on these data shows four times higher fertility levels for ever married women (5.9) as compared to never married women (1.5) (Figs.58-59).

Figure 58: Total Fertility Rate (TFR) by marital status, FSM: 2008-2010
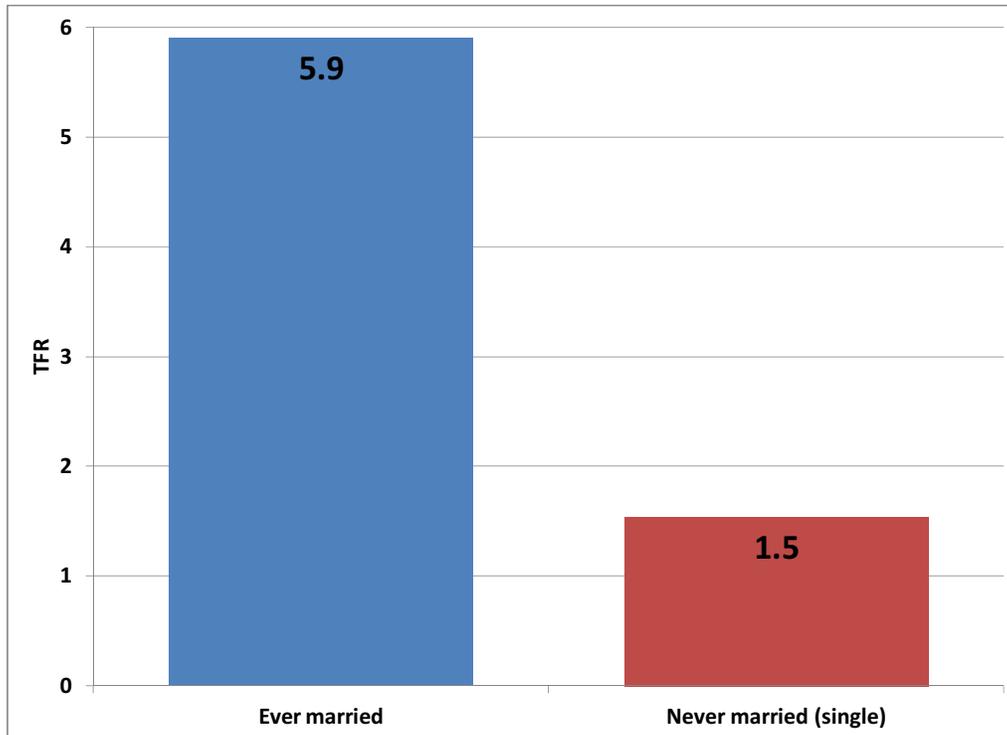
Nonetheless, bear in mind that not all children born to currently (meaning married at the time of the census enumeration) married women were born during their married state, and some of their children were born before they got married. As was shown in section 2.1.1 (Fig.14), a sizeable proportion of young women gave birth when they were not (yet) married, which raises the question what came first: childbirth or marriage? In general however, the data suggest that childbirth is very much entwined with marriage: if women were not married during her first childbirth, marriage will in most cases soon follow, and subsequent childbearing will occur during wedlock.

One aspect that is striking is the extremely high adolescent fertility rate of married women of almost 300 births per 1000 women aged 15-19 years, as well as the very high fertility rate of the 20-24 year old married women with 260 births per 1000 women in that age group. This can be explained by several points (Table 6):

- While only 8% (480) of women aged 15-19 years were married, they gave birth to more than half of all children born to women of that age group.
- Although only 37% (1,648) of women aged 20-24 years were married, they gave birth to almost three-quarter of all children born to women of the same age.

Again this raises the question whether these young unmarried women became pregnant and as a consequence of their pregnancy got married, or whether they married at a young age and therefore had a higher chance of falling pregnant. Unfortunately the census data cannot answer this question.

The only source of information that can shed light on this topic is the issued birth certificates which record a mother's age at birth of her child, marital status of mother, and birth order, among other information.

Figure 59: Age-specific Fertility Rates by marital status, FSM: 2008-2010
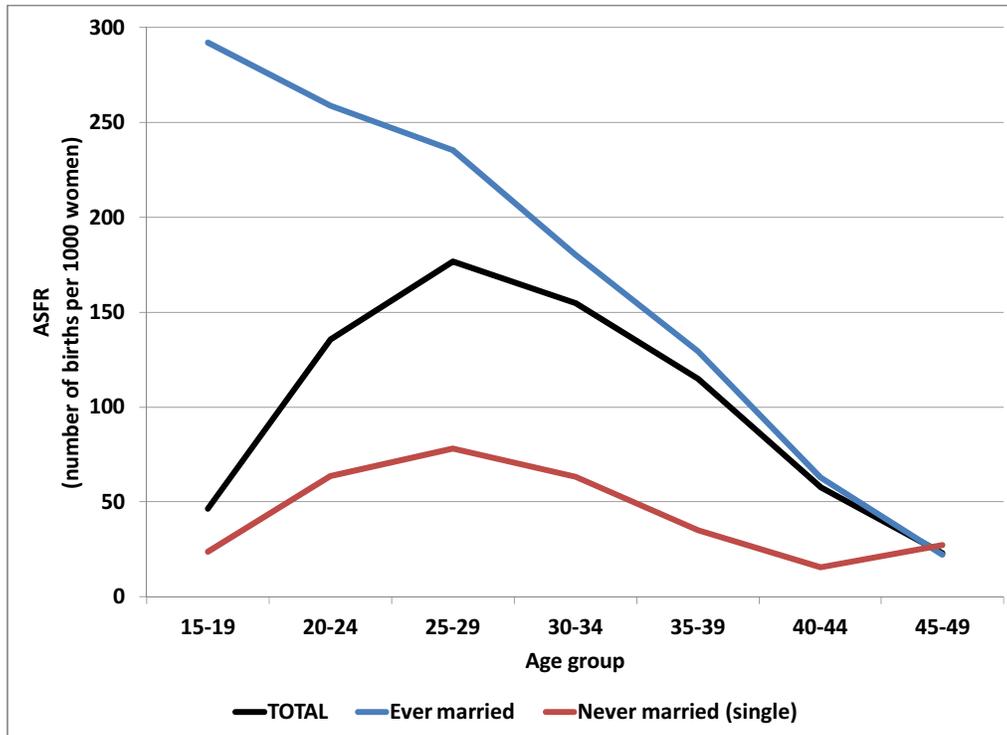
3.1.8 Past fertility

This section examines past fertility trends in the FSM, starting from 1954. The trend is an amalgamation of several different population counts:

- 1967, Peace Corps census (Pohnpei and Kosrae were combined);
- 1973, Trust Territory of the Pacific Islands (TTPI) census (Pohnpei and Kosrae were combined;
- 1980, Trust Territory of the Pacific Islands (TTPI) census (Kosrae was a separate state);
- 1985, Pohnpei census;
- 1986, Kosrae census;
- 1987, Yap census;
- 1989, Chuuk census;
- 1994, the first FSM nation census;
- 2000, FSM census;
- 2010, FSM census.

The application of the own-children method produced a TFR for each year of the 15-year period prior to each census, and although the different enumerations were undertaken in very different circumstances, the overall overlapping trend from one census to the next fits together very nicely (Fig.60). This historical data shows that the fertility transition had started in the late 1960s for Kosrae and Yap, in the early 1970s it commenced for Pohnpei, and it only really took hold of Chuuk in the mid-1980s. The data show that the overall fertility levels declined very rapidly and more than halved from a very high level of almost 8 children per woman in the early 1970s to 3.5 in 2010.

Figure 60: Total Fertility Rate (TFR) by State, FSM: 1954-2009
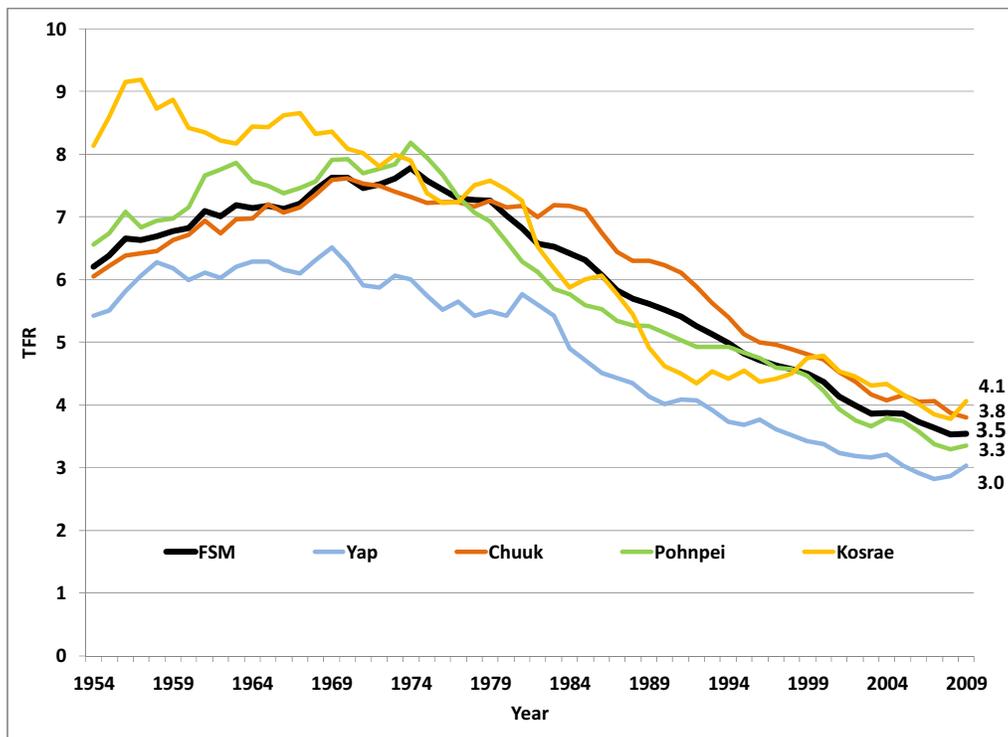
Source: Michael Levin, Harvard University Center for Population and Development Studies

4 Completeness of birth registration

The completeness of the registration of births in the FSM can be calculated by comparing the estimated number of births (that were derived through the application of the own-children method) with the registered number of births (Figure 61 and App.11). Assuming that the estimated number of births depicts an accurate picture of the true number of births that occurred during the years 2001-2009, the overall completeness of the FSM's birth registration has been calculated at **82%**. However, it seem to have slightly increased from just below 82% for the period 2001-2005, to just over 82% for the period 2005-2009.

The World Health Organization (WHO) in its assessment of national civil registration and vital statistics systems describe a completeness of 82% as "functional but inadequate". However, it should be noted that a system with 85% completeness is described as "satisfactory", and there were clearly several years of birth registration where such levels have been achieved.

Despite its shortcomings some interesting numbers should be cited here. During the period 2000-2010

- 98 births of women aged younger than 15 years were recorded, and
- 1,061 births of women aged 15-17 years.

Figure 61: Estimated and registered number of births, and completeness of birth registration, FSM: 2001-2009
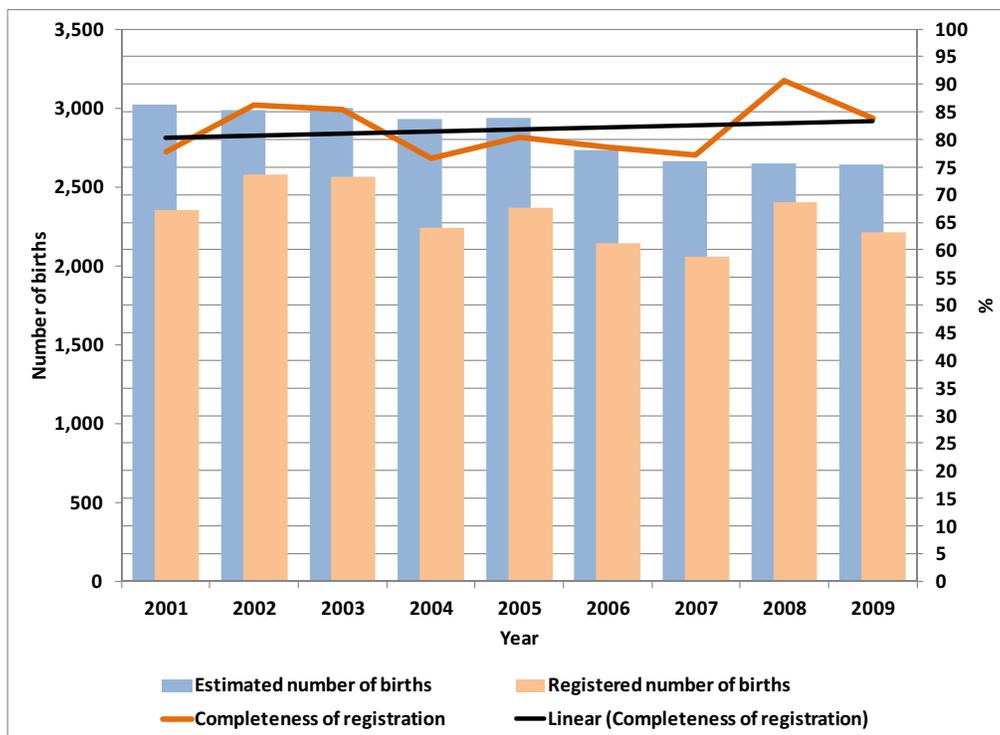
Source: Department of Health and Social Affairs, National office

The completeness of birth registration by State shows quite a varied picture; while birth registration was almost complete in Kosrae with 97% of all estimated births registered, it was 91% in Pohnpei, 73% in Yap, and only 66% in Chuuk (Fig.62).

The calculations are based on the total number of registered births of the 3-year period 2008-2010 as reported by the State Registrars, and the estimated numbers of births are based on estimated fertility levels and estimated number of females for the same years/period.

Figure 62: Estimated and registered number of births, and completeness of birth registration by State, FSM: 2008-2010
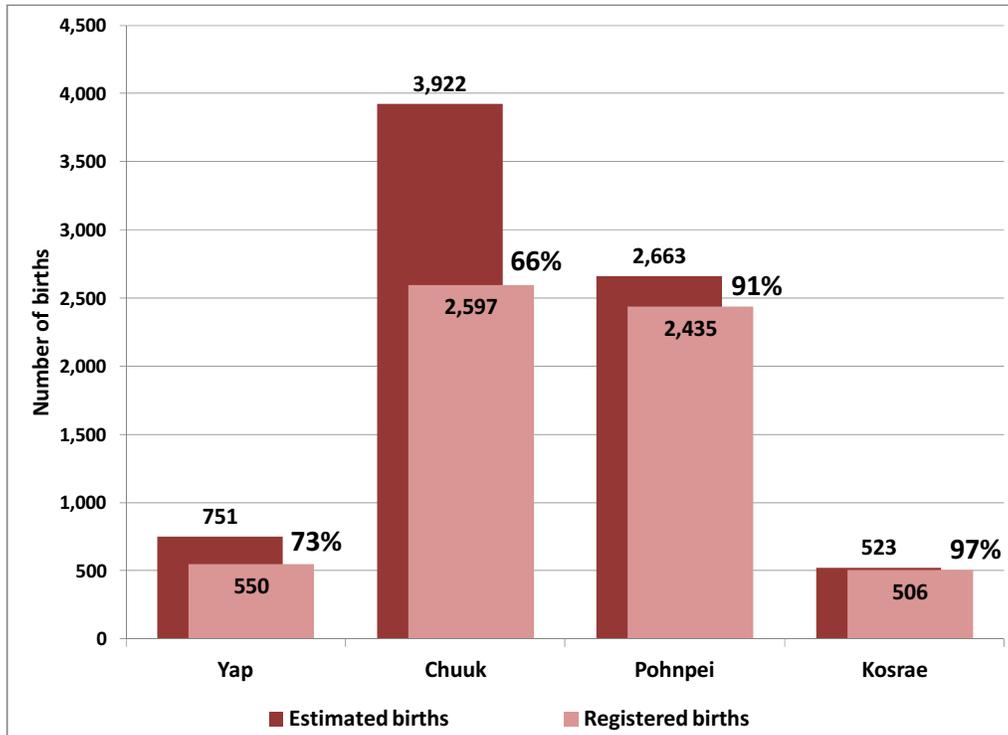
Source: Department of Health and Social Affairs, State offices

5 Use of Contraception

Based on data produced by the FSM Department of Health and Social Affairs in its Family Planning *Annual Reports* for the years 2007-2011, the number of contraceptive users of all methods continuously increased from 8,307 in 2007 to 13,690 in 2011 (Table 7).

The corresponding contraceptive prevalence rates for all women aged 15-44 and 15-49 years were calculated and it shows a steadily increasing trend from 35% in 2007 to 60% of women aged 15-44 years in 2011. More than 90% of all methods used were modern methods.

It is safe to assume that this increasing trend in contraceptive prevalence is the main mechanism through which the observed decrease in fertility rates in the FSM is being brought about.

Table 7: Contraceptive use by method and estimated Contraceptive Prevalence Rate (CPR), FSM: 2007-2010

Method	Year				
	2007	2008	2009	2010	2011
Modern methods					
Female sterilization	1,957	2,248	2,213	2,134	2,260
IUD	61	96	97	95	88
Hormonal implant	1,020	1,195	1,341	1,533	1,849
1-month injection	-	-	-	-	-
3-month injection	1,704	2,117	2,225	2,171	2,357
Oral contraceptive	940	667	850	929	567
Patch	-	-	-	-	-
Vaginal ring	-	-	-	-	-
Diaphragm	-	-	-	-	-
Sponge	-	-	-	-	-
Female condom	14	7	-	645	1,701
Spermicide	-	-	-	-	-
Male vasectomy	151	151	151	151	153
Male condom	1,742	3,420	4,346	3,851	3,654
Traditional methods					
Awareness method (FAM)	201	360	231	132	141
Abstinence	25	16	47	47	5
Other method (NFP)	467	785	632	1,237	910
Method unknown	25	-	-	-	5
All modern methods	7,589	9,901	11,223	11,509	12,629
All traditional methods	718	1,161	910	1,416	1,061
All methods	**8,307**	**11,062**	**12,133**	**12,925**	**13,690**
Estimated number of females aged 15-44	23,498	23,370	23,225	23,063	22,881
Estimated number of females aged 15-49	26,138	26,018	25,868	25,692	25,493
Contraceptive prevalence rate, 15-44 years (%)	**35**	**47**	**52**	**56**	**60**
Contraceptive prevalence rate, 15-49 years (%)	**32**	**43**	**47**	**50**	**54**

Source: Department of Health and Social Affairs, Family Planning Annual Reports, 2007-2011

6 Discussion of findings and conclusions

Previous chapters examined fertility levels and trends over the past five to six decades. It has been shown that fertility transition in FSM started in the early 1970s and the country witnessed a sustained decline in fertility. The Total Fertility Rate dropped from a high level of about 8 children per woman in 1973 to 3.5 in 2010. A reduction in fertility by more than half in four decades is significant.

It is found that there is no significant variation in the Total Fertility Rate between women in urban and rural areas, with a TFR of 3.4 in the urban, and 3.6 in the rural areas. However, the teenage fertility rate was with 49 births per women aged 15-19 years in the rural areas slightly higher than in the urban areas where it was only 38 births per 1000 teenage women.

Educational attainment of women is found to have a significant impact on fertility levels. Women who did not graduated or had completed only grade 12 or less had much higher number of children than high school graduates and women with tertiary education.

In addition, the census showed that employed women working for pay showed significantly lower levels of fertility than women who did subsistence work or were not in the labor force. The difference in the average number of children between these two groups of women is exactly 1 child on average.

Sustained decline in fertility and increasing longevity in the FSM over the past several decades have provided opportunities as well as challenges for socio-economic development of the nation. One of the inevitable consequences of fertility decline is the changes in age structure of the population, and the FSM will exhibit a gradual shift in the proportion of the young-age population and old-age population. While the proportion of the population under age 15 will decrease, the proportion of the population aged 60 years and older will increase.

6.1 Challenges

While fertility levels have steadily declined in the FSM during the last 40 years, it is still relatively high. Many women continue to have a large number of children; 21% of women aged 45-49 years had 7 children or more, and at age 30-34 years more than a quarter of all women had at least 4 children. Thus the need for education, family planning and reproductive health services remains high.

However, in the long run declining fertility and increasing longevity result in population ageing which is an emerging issue in many countries in the Pacific region, including the FSM. The implications of population ageing and associated growth in the size of elderly populations are of particular concern. They pose serious burdens on economic and social support and health care systems. The rising number of elderly on the one hand, and the declining number of the younger population on the other, also result in shortages of caregivers for the elderly population. As women outnumber men in the older ages due to their greater longevity, the social and financial security as well as the health conditions of elderly women will become one of the bigger challenges FSM policy makers will be facing.

The rising number of older persons has important policy implications for the provision of health and social services. In the FSM, as in many developing countries, the health-care infrastructure is weak and most of the resources are spent on salaries of health care workers. The provision of medical,

public health, social services and other facilities required to address the needs of the older persons are likely to put severe strain on the economy (Knodel, Ofstedal and Hermalin, 2002). Furthermore, as age is a major risk factor for non-communicable diseases such as cardiovascular disease, cancer and diabetes, population ageing increases the need for long-term health care systems. To offset the high costs for treatment and care associated with non-communicable diseases, there is a need for greater emphasis on disease prevention and screening for early detection (Bloom, 2011).

With an increasing number of younger women entering the labour force, often away from home, the availability of family-based caregivers for older persons will also decrease. Urbanization and migration contribute to erosion of traditional care systems resulting in increasing numbers of older persons to be left behind in rural areas without family support.

In the FSM, women are disadvantaged as they have lower education and less work experience than men and less income and access to assets and diminished authority within the family. Hence, women are more likely to be dependent upon family members and public programmes, especially at advanced ages and under conditions of illness and disability. These needs put extra pressure on family members for care giving. However, the caregivers are usually women who are caught up with multiple responsibilities of raising children, caring for elderly parents and engaging in economic activities—forming what is called "the sandwich generation". For this group of caregivers, more intensive and practical government support needs to be provided so as to enable them to support older persons, especially women.

6.2 Opportunities − Reaping the demographic dividend

Due to the recent decline in fertility, FSM has a relatively large working-age population. FSM's working-age population (15-64) currently constitutes over 61 percent of the total population and this percentage is likely to increase over the next few decades if the current declining trend in fertility levels continues. This large share of working-age population with relatively few dependent children and elderly to support provides a "window of opportunity" to build human capital.

The Demographic Dividend

Studies have revealed that the benefit afforded by the changing age structure, called "demographic dividend", will typically last for several decades (Seetharam, 2006). Its duration and intensity (the extent to which workers outnumber dependents) depend primarily on the rapidity and magnitude of the fertility decline. The "window of opportunity" opens only once, and typically closes within a generation as the population ages and dependency increases.

FSM's demographic window of opportunity opened up in the 1970s, when fertility rates started to decline, and it is expected to continue due to the likely gradual fertility decline in future. While the intensity of FSM's demographic dividend may not be as much as in some other countries, its protracted duration offers a unique opportunity to reap its benefits over an extended period of time.

As a consequence of age structural changes in population, the FSM will experience a significant shift in the dependency ratio: while the youth dependency burden will fall, old dependency burden will continue to rise. The total dependency ratio[4] has fallen significantly from 89 in 1994 to 64 in 2010, and is expected to decrease because of the anticipated fertility decline (Fig.63).

Figure 63: Projected age structure by broad age groups (%), FSM: 2000-2050
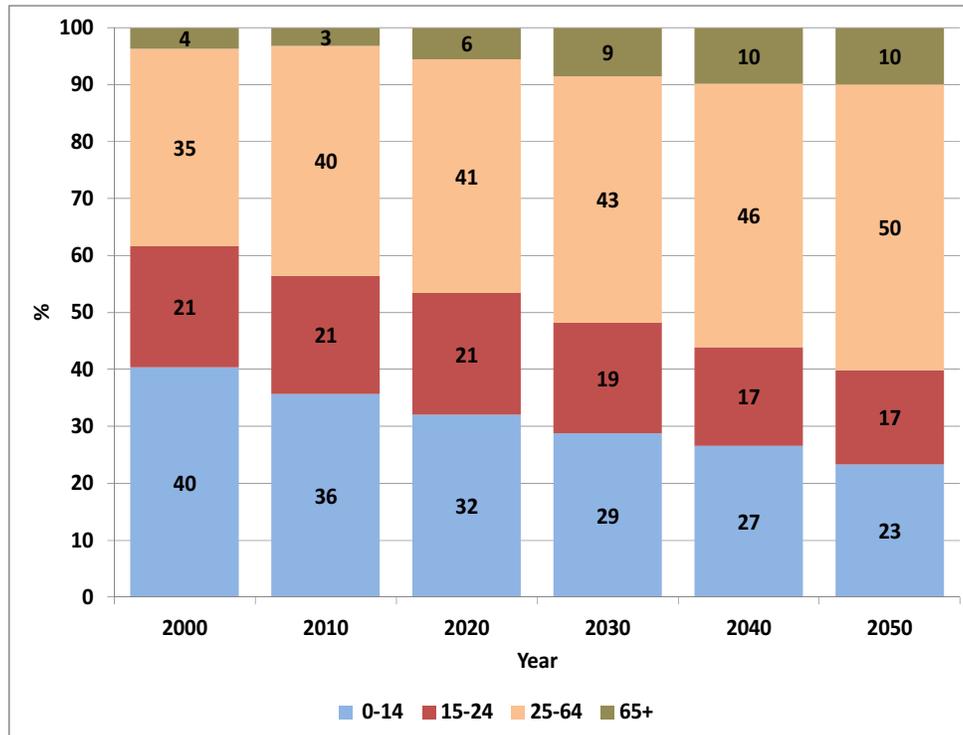
This demographic transition presents a unique opportunity for social and economic development. As the FSM experiences a significant and sustained increase in the proportion of working-age population the nation is currently well placed to reap the "demographic dividend" before its population starts to age. However, to fully capitalize on the benefit from the demographic dividend, the FSM would need to follow policy initiatives deployed by some East Asian countries who managed to accomplish economic "takeoff" during the period of their demographic dividend.

Some of the policy recommendations for stimulating economic growth as a result of demographic dividend include massive investment in education and human resources development.

Such investments should become possible as relatively large numbers of tax payers and relatively low numbers of people dependent on social services would result in savings. These savings should be properly invested to increase the capacity of the current and future labour force to participate fully in a skill-based economy.

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[4] The total dependency ratio is the number of persons under age 15 plus persons aged 65 years or over per one hundred persons 15-64. It is the sum of the youth dependency ratio and the old dependency ratio.

In conclusion, the importance of policy to reap the benefits of demographic dividend was demonstrated in Eastern Asia. With the demographic transition already fairly well advanced, the Government of FSM would need to urgently put in place appropriate social and economic policies designed to reap the benefit from demographic dividend and spur economic growth. David Bloom, however, cautioned that "reaping the demographic dividend is not automatic—it depends on the policy environment that emphasises population and family planning, good public health, good education, open labour market, free and fair trade, and good governance and economic management" (Bloom, 2002). Effective policies in those key areas allow maximum returns from concentration of the population in working ages. Transforming a youthful population into a productive workforce requires investment in education at all levels, while a larger, better-educated workforce will yield benefits only if they can find jobs. In many countries, necessary steps to reaping the benefits of the demographic dividend include strengthening the rule of law, improving the efficiency of government operation and reducing corruption (Bloom, Canning and Sevilla, 2003).

It is therefore important to create awareness among planners and policy makers of age structural changes brought about by the decline in fertility and increase in longevity. The relevance and prerequisites of the "demographic dividend" for investment planning and human resources development need to be well understood and translated into policy formulation. The demographic dividend is a one-time window of opportunity that FSM should not fail to fully benefit from

The Economic and Social Survey of the Asia and the Pacific 2010 States: "Not exploiting the demographic dividend can thus be costly. High unemployment, especially among youth, wastes human resources and can lead to higher crime, social unrest and political instability, with further ramifications on socio-economic prospects. Jobless growth and high and rising unemployment among youth (aged 15-24) in the region may indicate inadequate preparation to reap the benefits of the demographic dividend" (United Nations, 2010: 32).

In this context it needs to be noted that the FSM's high rate of population loss due to migration is a double-edged sword: while it reduces unemployment, it also drains the country from its productive people.

6.3 Recommendations for further research

This study has examined the fertility transition in the FSM over the past four decades using data from the 2010 census and earlier censuses. Due to the nature of data collected in the census, it was not possible to determine covariates of fertility decline or causal factors, such as contraceptive prevalence and unmet need for family planning, or utilization of health services, affecting the observed fertility levels. It is to be noted that there has been no demographic survey conducted in the FSM. It is therefore recommended to undertake an in-depth survey, such as Demographic and Health Survey (DHS) in the FSM which would permit detailed analysis of fertility, child mortality and reproductive health. This would also allow in-depth study of socio-economic, demographic and health factors affecting fertility and identification of proximate determinants of fertility, such as use of contraception, postpartum amenorrhea, age at marriage and abortion.

It is strongly recommended to consolidate and strengthen FSM's national and State **vital statistics systems**, and at the same time comprehensively extract and disseminate the available information on

- Number of births by age of mother;
- Number of births by birth order;
- Birth spacing;
- Birth weight;
- Prenatal care;
- Breastfeeding;
- Number of caesarean deliveries;
- Women's marital status;
- Women's employment status;
- Women's educational level;
- Father's age;
- Father's socio-economic background information;
- Contraceptive use;
- Complications during pregnancy/birth, incl. maternal mortality;
- HIV and STIs.

Appendices

Appendix 1: The demographic transition

According to the theory of demographic transition, over time all countries will undergo change from high rates of births and deaths to low rates of births and deaths. This transition process is usually closely associated with economic, social and scientific developments. This is assumed to happen in four distinct stages:

Stage 1: High birth rate, high death rate   → little or no population growth
Stage 2: High birth rate, falling death rate   → high growth
Stage 3: Declining birth rate, relatively low death rate   → slowed growth
Stage 4: Low birth rate, low death rate   → very low growth

Historically, high levels of births and deaths kept most populations from growing rapidly through time. In fact, many populations not only failed to grow but also completely died out when birth rates did not compensate for high death rates (**stage 1**). There are few populations/communities left today at stage 1.

Death rates eventually fell as living conditions, nutrition and public health improved. The decline in mortality usually preceded the decline in fertility, resulting in population growth during the transition period (**stage 2**). In Europe and other industrialised countries, death rates fell slowly. With the added benefit of medical advances, death rates fell more rapidly in the countries that began the transition in the 20th century. These are/were primarily developing countries. Their death rates often fell much faster than in European countries because they benefited from Western inventions and innovations.

In general, fertility rates fell neither as quickly nor as dramatically as death rates, and thus populations grew rapidly.

Stage 3 is characterized by falling birth rates, which occur for many reasons and vary from country to country and population to population. A decrease in birth rates may result from: a transition from a non-monetary to a monetary economy, urbanization, a change in values from a community emphasis to individualism, increasing emphasis on consumerism, improved education, availability of (modern) family planning methods (i.e. contraceptives), greater involvement of women in the workplace, rising cost of living, rising cost of raising children, and preferences in how people want to spend their time.

The demographic transition is regarded as completed when both birth and death rates have reached a low and stable level (**stage 4**). As a result, population growth is very low.

Originally, the theory of demographic transition included only the four stages described above. There is now another stage, the **post-transition period** (although it is uncertain whether all countries will reach this stage).

Post-transition period: Very low birth rate, low death rate   → negative growth

When fertility falls to very low levels and stays there for a protracted period, a slow rate of population growth can turn into a negative one, resulting in a population decrease. Many countries in Europe and some in Asia now have TFRs well below two children per woman. The TFRs of the Republic of Korea, Ukraine, Czech Republic, Slovakia, Slovenia, Republic of Moldova, Bulgaria, and Belarus — all about 1.2 — are among the world's lowest, and those of several other countries were not far behind. The TFRs of Macao and Hong Kong was even less than 1 child per woman on average. Many of the factors that lowered fertility in the first place — greater involvement of women in the workplace, rising cost of living, and preferences in how people want to spend their time — appear to be keeping fertility rates very low.

While the theory of demographic transition describes the population history of Western Europe quite well, for many reasons developing countries do not always exhibit the same patterns of change. In some cases early contact with outside societies resulted in local epidemics, as groups succumbed to diseases against which they had no natural immunity, resulting in increased death rates. When health conditions improved as a result of the application of new and efficient disease control technologies, death rates declined, while birth rates sometimes increased. This combination of factors produced population growth rates in today's developing countries that are much higher than ever experienced in pre-industrial Western Europe.

Stylised graph of the European demographic transition
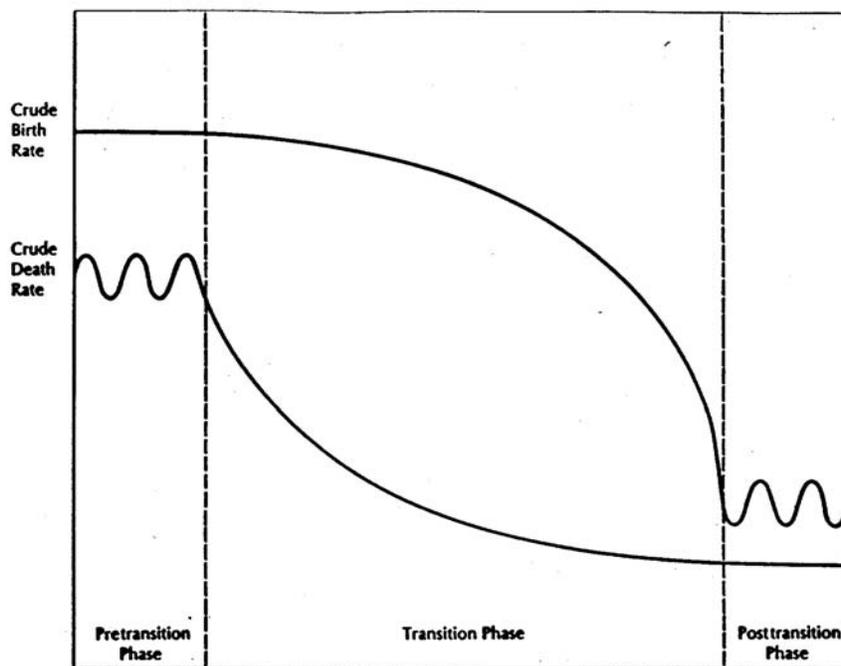
Figure 3–2 A SIMPLIFIED DIAGRAM OF THE EUROPEAN DEMOGRAPHIC TRANSITION
Source: Ansley J. Coale, 1974, p. 49.

Appendix 2: Age Specific Fertility Rates (ASFR) and Total Fertility Rates (TFR) derived by the Own-children method for single years, FSM: 1996-2010

Federated States of Micronesia 2010 Census Own Child Fertility Estimates														
Single Years														
TOTAL														
Age	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996
15-19	41	48	50	55	57	66	63	69	74	75	77	78	83	67	93
20-24	131	133	143	135	157	145	164	165	164	183	185	199	207	194	196
25-29	181	169	179	169	197	178	188	185	182	214	204	214	224	204	234
30-34	164	154	147	157	160	162	155	163	162	181	199	193	192	195	196
35-39	112	119	113	105	124	124	128	126	106	130	126	142	134	133	140
40-44	66	56	51	55	53	59	66	55	48	64	60	64	72	74	60
45-49	20	26	23	26	26	26	17	21	13	16	19	22	25	18	23
TFR	3,574	3,526	3,530	3,512	3,868	3,800	3,904	3,918	3,746	4,313	4,350	4,560	4,689	4,423	4,703
YAP														
Age	2,010	2,009	2,008	2,007	2,006	2,005	2,004	2,003	2,002	2,001	2,000	1,999	1,998	1,997	1,996
15-19	46	44	57	46	46	65	48	67	72	54	86	55	63	67	84
20-24	150	131	149	120	158	114	118	121	137	179	144	136	196	187	154
25-29	190	175	128	155	138	125	158	156	137	155	183	201	152	191	201
30-34	135	94	109	147	123	140	153	135	126	157	147	146	149	151	159
35-39	84	92	90	46	70	121	94	147	80	71	118	103	100	95	94
40-44	44	42	23	55	16	39	52	34	26	38	21	39	53	73	2
45-49	16	13	6	0	11	10	20	8	7	2	0	14	19	13	0
TFR	3,324	2,952	2,801	2,850	2,809	3,068	3,207	3,344	2,927	3,279	3,495	3,463	3,661	3,882	3,473
CHUUK														
Age	2,010	2,009	2,008	2,007	2,006	2,005	2,004	2,003	2,002	2,001	2,000	1,999	1,998	1,997	1,996
15-19	37	54	55	58	60	58	61	63	66	71	71	66	70	58	69
20-24	128	119	130	129	147	149	157	161	161	188	174	202	185	184	185
25-29	168	172	188	184	222	174	204	205	194	232	210	226	250	209	252
30-34	165	177	170	166	178	155	168	179	187	202	228	223	237	214	209
35-39	125	141	129	122	151	135	147	137	134	164	144	171	165	165	188
40-44	83	76	70	76	84	68	82	73	68	89	80	82	96	100	81
45-49	25	31	36	43	41	30	21	18	11	20	24	23	28	22	32
TFR	3,660	3,851	3,888	3,884	4,412	3,847	4,198	4,185	4,103	4,827	4,650	4,959	5,159	4,760	5,076
POHNPEI														
Age	2,010	2,009	2,008	2,007	2,006	2,005	2,004	2,003	2,002	2,001	2,000	1,999	1,998	1,997	1,996
15-19	44	41	44	55	55	78	70	75	86	89	84	105	107	82	126
20-24	123	152	152	143	164	147	181	178	179	178	211	222	233	209	217
25-29	182	157	178	141	189	201	180	162	177	208	193	198	220	202	222
30-34	166	139	139	150	146	172	141	154	129	157	179	164	154	192	178
35-39	99	101	102	104	103	113	114	97	88	101	102	106	116	107	114
40-44	53	39	43	34	31	57	47	40	36	47	48	51	51	46	57
45-49	15	25	15	21	17	27	11	28	22	18	26	28	27	15	25
TFR	3,405	3,273	3,363	3,239	3,523	3,971	3,715	3,672	3,589	3,988	4,209	4,371	4,533	4,260	4,693
KOSRAE														
Age	2,010	2,009	2,008	2,007	2,006	2,005	2,004	2,003	2,002	2,001	2,000	1,999	1,998	1,997	1,996
15-19	48	45	45	37	63	56	53	85	72	64	79	53	70	33	72
20-24	176	126	183	157	194	165	197	207	141	186	196	173	226	187	216
25-29	265	221	219	265	160	182	182	238	215	244	278	252	216	208	242
30-34	206	200	102	155	192	201	155	157	263	218	208	247	202	170	292
35-39	158	132	113	112	169	113	153	161	68	178	152	233	109	160	91
40-44	67	41	25	33	40	57	99	60	31	52	75	68	70	55	74
45-49	16	26	20	8	20	30	24	30	0	5	0	6	6	13	0
TFR	4,681	3,951	3,531	3,834	4,187	4,013	4,308	4,689	3,946	4,734	4,934	5,154	4,497	4,123	4,930

Source: Michael Levin, Harvard University Center for Population and Development Studies

Appendix 3: Age Specific Fertility Rates (ASFR) and Total Fertility Rates (TFR) derived by the Own-children method for multi-year averages, FSM: 1996-2010

Federated States of Micronesia 2010 Census Own Child Fertility Estimates									
5 year rates					**3 year rates**				
TOTAL									
Age	2006-10	2001-05	1996-00	2004-08	1999-03	2008-10	2005-07	2002-04	1999-01	1996-98
15-19	50	69	80	58	75	46	59	69	77	81
20-24	140	164	196	149	179	136	146	164	189	199
25-29	179	189	216	182	200	177	181	185	211	221
30-34	156	165	195	156	179	155	160	160	191	194
35-39	115	123	135	119	126	115	117	120	133	136
40-44	56	59	66	57	58	58	56	56	63	69
45-49	24	19	21	24	18	23	26	17	19	22
TFR	3,598	3,933	4,544	3,718	4,172	3,542	3,725	3,857	4,406	4,606
YAP									
Age	2006-10	2001-05	1996-00	2004-08	1999-03	2008-10	2005-07	2002-04	1999-01	1996-98
15-19	48	61	71	52	67	49	52	62	65	71
20-24	142	134	163	132	143	143	131	125	153	179
25-29	157	146	186	141	166	164	139	150	180	181
30-34	121	142	150	134	142	112	137	138	150	153
35-39	77	103	102	84	104	89	79	107	98	96
40-44	36	38	38	37	31	36	37	37	33	44
45-49	9	10	9	9	6	11	7	12	5	11
TFR	2,948	3,167	3,595	2,946	3,300	3,025	2,911	3,162	3,412	3,682
CHUUK									
Age	2006-10	2001-05	1996-00	2004-08	1999-03	2008-10	2005-07	2002-04	1999-01	1996-98
15-19	52	64	67	58	67	48	59	63	69	66
20-24	130	163	186	142	176	126	142	160	188	185
25-29	186	202	229	194	213	176	193	201	223	237
30-34	171	178	222	168	204	171	166	178	218	220
35-39	134	143	166	137	150	132	136	140	160	172
40-44	78	76	88	76	78	76	76	74	84	93
45-49	35	20	26	34	19	31	38	17	22	27
TFR	3,928	4,225	4,919	4,043	4,538	3,796	4,048	4,163	4,812	5,000
POHNPEI									
Age	2006-10	2001-05	1996-00	2004-08	1999-03	2008-10	2005-07	2002-04	1999-01	1996-98
15-19	48	79	100	60	87	43	63	77	92	105
20-24	146	172	218	157	193	142	151	179	203	219
25-29	169	185	207	177	188	172	176	173	200	214
30-34	148	151	173	150	156	148	156	142	167	174
35-39	102	103	109	107	99	101	106	100	103	112
40-44	40	46	50	42	44	45	40	41	49	51
45-49	19	21	24	18	24	18	21	20	24	22
TFR	3,358	3,786	4,409	3,554	3,959	3,345	3,571	3,658	4,187	4,493
KOSRAE									
Age	2006-10	2001-05	1996-00	2004-08	1999-03	2008-10	2005-07	2002-04	1999-01	1996-98
15-19	47	66	62	51	71	46	52	70	66	58
20-24	166	179	199	179	181	161	172	182	185	210
25-29	227	212	239	201	245	236	202	212	258	222
30-34	171	199	224	160	218	169	182	192	224	221
35-39	137	134	147	132	158	134	131	128	188	120
40-44	41	59	69	51	58	45	43	62	65	66
45-49	18	19	5	21	9	21	20	18	4	6
TFR	4,037	4,338	4,718	3,966	4,699	4,060	4,010	4,318	4,942	4,517

Source: Michael Levin, Harvard University Center for Population and Development Studies

Appendix 4: Arriaga's approach for estimation of ASFR for one point (2000) in time and the age pattern of fertility (Brass)

Month   April
Year   **2000**
Fertility pattern is tabulated by age of woman at: enumeration

Age Group of Woman	Children Ever Born	Age Fertility Pattern (A.S.F.P.)	Fertility Consistent with C.E.B. (A.S.F.R.)	Fertility Pattern by Age at Survey Date (Recorded)	Fertility Pattern by Age at Birth of Child (Calculated)	A.S.F.R.	Fertility Pattern by Age at Birth	Adjustment Factors	Rates 20 - 25	Rates 25 - 30	Rates 20 - 30
Apr-10											
15 - 20	0.099	0.037	0.070	0.037	0.046	0.070	0.046	1.512	0.054	0.055	0.054
20 - 25	0.781	0.161	0.181	0.161	0.170	0.251	0.217	1.159	0.198	0.202	0.200
25 - 30	1.793	0.190	0.231	0.190	0.190	0.482	0.407	1.184	0.220	0.225	0.223
30 - 35	3.064	0.171	0.253	0.171	0.167	0.735	0.574	1.281	0.193	0.197	0.195
35 - 40	4.198	0.117	0.199	0.117	0.112	0.934	0.685	1.363	0.130	0.132	0.131
40 - 45	5.145	0.058	0.132	0.058	0.052	1.066	0.738	1.445	0.061	0.062	0.061
45 - 50	5.702	0.016	0.047	0.016	0.012	1.114	0.750	1.485	0.014	0.015	0.014
Mean Age of Childbearing:		29.57			28.10						
Total Fertility Rate:		5.57			3.75				4.35	4.44	4.39

Software: MORTPAK for Windows (version 4.1), application FERTPF, Population Division, United Nations Secretariat

Appendix 5: Arriaga's approach for estimation of ASFR for one point (2010) in time and the age pattern of fertility (Brass)

Month   April
Year   **2010**
Fertility pattern is tabulated by age of woman at: enumeration

Age Group of Woman	Children Ever Born	Age Fertility Pattern (A.S.F.P.)	Fertility Consistent with C.E.B. (A.S.F.R.)	Fertility Pattern by Age at Survey Date	Fertility Pattern by Age at Birth of Child	A.S.F.R.	Fertility Pattern by Age at Birth	Adjustment Factors	Rates 20 - 25	Rates 25 - 30	Rates 20 - 30
				Recorded	Calculated						
Apr-10											
15 - 20	0.068	0.033	0.048	0.033	0.040	0.048	0.040	1.197	0.044	0.043	0.043
20 - 25	0.568	0.128	0.144	0.128	0.137	0.192	0.177	1.085	0.148	0.146	0.147
25 - 30	1.395	0.169	0.177	0.169	0.169	0.369	0.346	1.068	0.183	0.180	0.182
30 - 35	2.276	0.136	0.160	0.136	0.131	0.530	0.477	1.109	0.143	0.140	0.142
35 - 40	2.979	0.098	0.135	0.098	0.093	0.665	0.571	1.165	0.101	0.100	0.101
40 - 45	3.721	0.046	0.103	0.046	0.041	0.767	0.611	1.255	0.044	0.043	0.044
45 - 50	4.231	0.008	0.037	0.008	0.005	0.805	0.617	1.305	0.006	0.006	0.006
Mean Age of Childbearing:			29.41		27.95						
Total Fertility Rate:			4.02		3.08				3.35	3.29	**3.32**

Software: MORTPAK for Windows (version 4.1), application FERTPF, Population Division, United Nations Secretariat

Appendix 6: Arriaga's approach for estimation of ASFR for two points (2000 and 2010) in time and the age patterns of fertility (Arriaga-Brass)

First Enumeration, Apr. 2000

Fertility pattern is tabulated by age of woman at enumeration

April 2000 to April 2001

Age Group of Women	Children Ever Born	Age Specific Fertility Pattern	Fertility Consistent with C.E.B. (A.S.F.R.)	Fertility Pattern by Age at Survey Date	Fertility Pattern by Age at Birth of Child	Cumulation of A.S.F.R.	Cumulation of Fertility Pattern by Age at Birth	Adjustment Factors	Age Specific Fertility Rates Based on Adjustment Factor for the Age Group 20 - 25	25 - 30	20 - 30
				Recorded	Calculated						
15 - 20	0.099	0.037	0.066	0.037	0.046	0.066	0.046	1.421	0.048	0.047	0.047
20 - 25	0.781	0.161	0.158	0.161	0.170	0.224	0.217	1.034	0.176	0.172	0.174
25 - 30	1.793	0.190	0.187	0.190	0.190	0.411	0.407	1.011	0.197	0.192	0.194
30 - 35	3.064	0.171	0.169	0.171	0.167	0.581	0.574	1.012	0.172	0.168	0.170
35 - 40	4.198	0.117	0.075	0.117	0.112	0.656	0.685	0.957	0.116	0.113	0.114
40 - 45	5.145	0.058	0.038	0.058	0.052	0.693	0.738	0.940	0.054	0.053	0.054
45 - 50	5.702	0.016	0.014	0.016	0.012	0.708	0.750	0.943	0.013	0.012	0.013
Mean Age of Childbearing:			27.34		28.10						
Total Fertility Rate:			3.54		3.75				3.88	3.79	3.83

Second Enumeration, Apr. 2010

Fertility pattern is tabulated by age of woman at enumeration

April 2009 to April 2010

Age Group of Women	Children Ever Born	Age Specific Fertility Pattern	Fertility Consistent with C.E.B. (A.S.F.R.)	Fertility Pattern by Age at Survey Date	Fertility Pattern by Age at Birth of Child	Cumulation of A.S.F.R.	Cumulation of Fertility Pattern by Age at Birth	Adjustment Factors	Age Specific Fertility Rates Based on Adjustment Factor for the Age Group 20 - 25	25 - 30	20 - 30
				Recorded	Calculated						
15 - 20	0.068	0.033	0.046	0.033	0.040	0.046	0.040	1.146	0.039	0.036	0.038
20 - 25	0.568	0.128	0.125	0.128	0.137	0.171	0.177	0.966	0.132	0.122	0.127
25 - 30	1.395	0.169	0.139	0.169	0.169	0.310	0.346	0.897	0.163	0.151	0.157
30 - 35	2.276	0.136	0.086	0.136	0.131	0.396	0.477	0.829	0.127	0.118	0.122
35 - 40	2.979	0.098	0.018	0.098	0.093	0.414	0.571	0.725	0.090	0.084	0.087
40 - 45	3.721	0.046	0.010	0.046	0.041	0.423	0.611	0.693	0.039	0.036	0.038
45 - 50	4.231	0.008	0.004	0.008	0.005	0.427	0.617	0.692	0.005	0.005	0.005
Mean Age of Childbearing:			25.81		27.95						
Total Fertility Rate:			2.14		3.08				2.98	2.76	2.87

Software: MORTPAK for Windows (version 4.1), application FERTPF, Population Division, United Nations Secretariat

Appendix 7: Fertility estimates using the Trussell P/F Ratio Technique, FSM: 2000

Age	Reported ASFR f(i)	Average CEB P(i)	Cumulative fertility Phi(i)	F(i)	P/F ratio
15-19	0.037	0.099	0.187	0.074	1.346
20-24	0.161	0.781	0.995	0.641	1.219
25-29	0.190	1.793	1.947	1.564	1.147
30-34	0.171	3.064	2.801	2.480	1.236
35-39	0.117	4.198	3.387	3.171	1.324
40-44	0.058	5.145	3.679	3.573	1.440
45-49	0.016	5.702	3.756	3.738	1.525
Age code	0				
TFR	3.756				

* Age code: ASFR based on age of mother at:

0   census/survey

1   birth of child

		Adjusted ASFR's				
		P2/F2	P3/F3	P4/F4	Avg(P3/F3,P4/F4)	**Avg(P2/F2,P3/F3)**
Age	ASFR *	1.219	1.147	1.236	1.191	1.183
15-19	0.047	0.057	0.054	0.058	0.056	0.056
20-24	0.171	0.208	0.196	0.211	0.204	0.202
25-29	0.191	0.232	0.218	0.235	0.227	0.225
30-34	0.166	0.203	0.191	0.206	0.198	0.197
35-39	0.112	0.137	0.128	0.138	0.133	0.133
40-44	0.053	0.064	0.060	0.065	0.063	0.062
45-49	0.012	0.014	0.014	0.015	0.014	0.014
TFR	3.76	4.58	4.31	4.64	4.47	**4.44**

* Pattern corrected for one-half year between birth and reporting.

ASFR   Age-specific fertility rate.

CEB   Average number of children ever born.

Software: Population Analysis Spreadsheets (PAS), procedure PFRATIO, US Census Bureau, Washington, USA

Appendix 8: Fertility estimates using the Trussell P/F Ratio Technique, FSM: 2010

Age	Reported ASFR f(i)	Average CEB P(i)	Cumulative fertility Phi(i)	F(i)	P/F ratio
15-19	0.033	0.068	0.163	0.066	1.031
20-24	0.128	0.568	0.803	0.510	1.112
25-29	0.169	1.395	1.649	1.316	1.061
30-34	0.136	2.276	2.327	2.070	1.099
35-39	0.098	2.979	2.816	2.638	1.129
40-44	0.046	3.721	3.046	2.975	1.251
45-49	0.007	4.231	3.084	3.075	1.376
Age code	0				
TFR	3.084				

* Age code: ASFR based on age of mother at:

0   census/survey

1   birth of child

				Adjusted ASFR's	
		P2/F2	P3/F3	P4/F4	Avg(P3/F3,P4/F4)	**Avg(P2/F2,P3/F3)**
Age	ASFR *	1.112	1.061	1.099	1.080	1.086
15-19	0.040	0.045	0.043	0.044	0.044	0.044
20-24	0.137	0.152	0.145	0.150	0.148	0.148
25-29	0.169	0.188	0.179	0.186	0.182	0.183
30-34	0.131	0.146	0.139	0.145	0.142	0.143
35-39	0.093	0.104	0.099	0.103	0.101	0.101
40-44	0.041	0.045	0.043	0.045	0.044	0.044
45-49	0.005	0.006	0.006	0.006	0.006	0.006
TFR	3.08	3.43	3.27	3.39	3.33	**3.35**

* Pattern corrected for one-half year between birth and reporting.

ASFR   Age-specific fertility rate.

CEB   Average number of children ever born.

Software: Population Analysis Spreadsheets (PAS), procedure PFRATIO, US Census Bureau, Washington, USA

Appendix 9: Fertility estimates using the Relational Gompertz method, FSM: 2000 and 2010

Summary Estimates of the Total Fertility Rate - 2000

Age	Based on CEB only		Based on ASFR and CEB	
	2+2 points	3+3 points	2+2 points	3+3 points
15-19	4.923	5.147	6.068	5.436
20-24	5.709	6.258	4.617	5.001
25-29	5.425	5.911	4.224	4.648
30-34	5.562	5.944	4.556	4.906
35-39	5.504	5.742	4.870	5.084
40-44	5.546	5.643	5.302	5.378
45-49	5.744	5.760	5.711	5.720
Average	5.488	5.772	5.050	5.167
Average (20-44)	5.549	5.900	**4.71**	**5.00**

2+2 points based on the age groups 15-19 to 35-39

3+3 points based on the age groups 15-19 to 45-49

CEB   Children ever born.

ASFR Age-specific fertility rate.

Summary Estimates of the Total Fertility Rate - 2010

Age	Based on CEB only		Based on ASFR and CEB	
	2+2 points	3+3 points	2+2 points	3+3 points
15-19	3.601	3.596	4.365	3.865
20-24	3.568	4.713	3.306	3.405
25-29	3.581	4.759	3.218	3.380
30-34	3.625	4.536	3.328	3.463
35-39	3.600	4.148	3.424	3.504
40-44	3.888	4.114	3.824	3.852
45-49	4.244	4.280	4.237	4.240
Average	3.729	4.307	3.672	3.673
Average (20-44)	3.652	4.454	**3.42**	**3.52**

2+2 points based on the age groups 15-19 to 35-39

3+3 points based on the age groups 15-19 to 45-49

CEB   Children ever born.

ASFR Age-specific fertility rate.

Software: Population Analysis Spreadsheets (PAS), procedure REL-GMPZ, US Census Bureau, Washington, USA

Appendix 10: Adolescent Fertility Rates by State, FSM: 1996-2010

State	Period				
	1996-98	1999-01	2002-04	2005-07	2008-10
Yap	71	65	62	52	49
Chuuk	66	69	63	59	48
Pohnpei	105	92	77	63	43
Kosrae	58	66	70	52	46
FSM	**81**	**77**	**69**	**59**	**46**

Appendix 11: Number of registered live-births by sex and age of mother, FSM: 2000 – 2010

Sex of Child / Age of mother	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
TOTAL	2,415	2,352	2,576	2,567	2,243	2,365	2,145	2,055	2,404	2,215	1,933
10 - 14	7	8	9	10	9	7	7	15	8	7	11
15 - 17	112	110	101	112	103	90	89	69	99	89	87
18 - 19	191	186	179	191	161	182	155	135	159	165	167
20 - 24	588	560	676	673	636	656	621	582	562	588	527
25 - 29	571	565	607	656	534	572	519	498	564	572	495
30 - 34	397	425	460	439	398	430	379	374	432	380	325
35 - 39	296	272	314	317	291	279	261	210	282	258	224
40 - 44	67	62	83	77	48	55	43	50	41	47	34
45 +	24	21	19	17	10	7	7	5	8	6	3
NS	162	143	128	75	53	87	64	117	249	103	60
Males	1,264	1,188	1,352	1,315	1,123	1,222	1,071	1,093	1,237	1,196	966
10 - 14	4	6	5	7	8	3	3	12	6	3	6
15 - 17	62	67	53	51	56	54	46	36	46	54	48
18 - 19	105	101	93	95	80	96	81	67	73	80	83
20 - 24	312	285	372	331	302	304	306	320	284	315	250
25 - 29	302	274	307	352	264	309	234	255	306	330	247
30 - 34	201	206	241	231	198	220	194	204	228	198	159
35 - 39	148	133	160	164	154	152	150	107	144	135	116
40 - 44	33	32	45	38	28	34	20	24	9	21	16
45 +	13	11	10	13	5	4	4	1	4	2	3
NS	84	73	66	33	28	46	33	67	137	58	38
Females	1,151	1,164	1,224	1,252	1,120	1,143	1,074	962	1,167	1,019	967
10 - 14	3	2	4	3	1	4	4	3	2	4	5
15 - 17	50	43	48	61	47	36	43	33	53	35	39
18 - 19	86	85	86	96	81	86	74	68	86	85	84
20 - 24	276	275	304	342	334	352	315	262	278	273	277
25 - 29	269	291	300	304	270	263	285	243	258	242	248
30 - 34	196	219	219	208	200	210	185	170	204	182	166
35 - 39	148	139	154	153	137	127	111	103	138	123	108
40 - 44	34	30	38	39	20	21	23	26	32	26	18
45 +	11	10	9	4	5	3	3	4	4	4	
NS	78	70	62	42	25	41	31	50	112	45	22

Source: Department of Health and Social Affairs

Glossary

Indicator	Definition
Adolescent (teenage) fertility rate	Number of births by women aged 15–19 years per 1,000
Age-specific fertility rate (ASFR)	Number of births for every 1000 women by age group
Balance equation	Population growth = births – deaths + net migration
Child-woman ratio (CWR)	Number of children under age 5 per 1,000 women aged 15-49 years
Completed fertility	The *parity* of women aged 45-49 years
Crude birth rate (CBR)	Number of births per 1,000 population
Crude death rate (CDR)	Number of deaths per 1,000 population
General fertility rate	Annual number of births per 1,000 women of childbearing age (15-49)
Infant mortality rate (IMR)	Number of infant deaths (children younger than 1 year) per 1,000 births
Mean age at childbearing	Average age of women when giving birth
Net migration	Difference between number of arrivals and departures, and/or difference between total population growth and natural increase
Parity	Total number of children born per (age of) woman
Rate of growth	Average annual population growth given in per cent (%)
Rate of natural increase	Crude birth rate (CBR) minus crude death rate (CDR)
Sex ratio at birth	Number of male births per 100 female births
Singulate mean age at (first) marriage (SMAM)	Approximation of average age at marriage, based on proportion of population never married (single)
Total fertility rate (TFR)	Average number of children born per woman throughout her lifetime (sum of the age-specific fertility rates multiplied by 5)

Endnotes

[i] The original P/F ratio method or Brass method seeks to adjust the level of observed age-specific fertility rates, which are assumed to represent the true age pattern of fertility, to agree with the level of fertility indicated by the averages parities of women in age groups lower than ages 30 or 35, which are assumed to be accurate. Measures of average parity equivalents, F, comparable reported average parities, P, are obtained from period fertility rates by cumulation and interpolation (these measures are effectively averages of the cumulated fertility schedule over age groups). Ratios of average parities (P) to the estimated parity equivalents (F) are calculated age group by age group, and an average of the ratios obtained for younger women is used as an adjustment factor by which all the observed period fertility rates are multiplied. Note that P/F ratios are generally calculated for the entire age range from 15-49, even though not all the ratios are used for adjustment purposes. This practice is recommended because the pattern of the ratios with age may reveal data errors or fertility trends. During successful application of this method, the age pattern of the period fertility rates is combined with the level implied by the average parities of younger women to derive at a set of fertility rates that is generally more reliable than either of its constituent parts. Average parity equivalents, F(i), are estimated by interpolation using period fertility rates f(i) and the cumulated fertility values Φ(i) calculated in previous steps. Several procedures have been proposed for this interpolation. Brass uses a simple polynomial model of fertility to calculate the relationship between average parity and cumulated fertility for successive age groups for a range of age locations of the fertility model. Coale and Trussell (Ansley Coale and T. James Trussell, "Model fertility schedule variations in the age structure of childbearing in human populations". Population Index, vol. 40, No 2 (April 1974), pp. 185-258) propose fitting a second degree polynomial to the three consecutive values of Φ(i) and estimating the average parity of women of an age group within the range by evaluating the integral of the polynomial; in an actual application, F(i) is obtained as F(i) = Φ(i-1) + af(i) + bf (i+1) (UN, Manual X, 1983).

[ii] Many censuses and surveys include questions related specifically to fertility, for example, the numbers of children women have ever had, and whether they had a birth in the year preceding the inquiry. The method seeks to adjust the level of observed age-specific fertility rates, which are assumed to represent the true age pattern of fertility, to agree with the level of fertility indicated by the average parities (average number of children ever born) of women in age groups under 30 or 35, which are assumed to be accurate. During successful application of this method, the age pattern of the period fertility rates is combined with the level implied by the average parities of younger women to derive a set of fertility rates that is generally more reliable than either of its constituent parts. Responses to such questions can be used to estimate fertility indirectly. Some techniques for doing this include the parity/fertility (P/F) ratio method developed by Brass, based on the average number of children ever born to women in five-year age groups, and women's age pattern of fertility derived from births in the year preceding the census or survey; and the Arriaga technique, which is similar to the P/F ratio method but links data for more than one date. While the Brass P/F ratio method assumes constant fertility in the past, the Arriaga method does not.

[iii] The relational Gompertz method seeks to estimate age-specific and total fertility by determining the shape of the fertility schedule from data on recent births reported in censuses or surveys while determining its level from the reported average parities of younger women. It is based on two assumptions about the typical errors in fertility data collected in censuses and surveys: any errors in the reporting of recent fertility are assumed to affect all age groups of women to the same degree, while lifetime fertility is assumed to be reported accurately by younger, but not older, women. The method is an improved, and more versatile, version of the Brass P/F ratio method and uses the same input data (and makes the same assumptions about errors that affect fertility data) as its precursor. Importantly, the method does not require an assumption that fertility has been constant in the past. In producing estimates of age-specific and total fertility, the method seeks to remedy the errors commonly found in fertility data associated with too few or too many births being reported in the reference period, and the under-reporting of lifetime fertility and errors of age reporting among older women.