

To the soul of my beloved father

To tell him thank you, for everything he has done
For he made me what I am

You were more than just a father

I miss you.....

From DEPARTMENT OF PUBLIC HEALTH SCIENCES/
DIVISION OF GLOBAL HEALTH (IHCAR)
Karolinska Institutet, Stockholm, Sweden

FEMALE GENITAL MUTILATION

DETERMINANTS AND CONSEQUENCES AMONG GIRLS AND WOMEN IN SUDAN

Sozan Elmusharaf



**Karolinska
Institutet**

Stockholm 2013

All previously published papers were reproduced with permission from the publisher.

Published by Karolinska Institutet. Printed by Universitetservice US-AB

© Sozan Elmusharaf, 2013
ISBN 978-91-7549-341-1

ABSTRACT

Background: Female genital mutilation (FGM) is still a reality in Sudan, Egypt and sub-Saharan Africa with three million girls at risk of being subjected to the practice annually and approximately 140 million girls and women currently living with its consequences worldwide.

Five hospital-based studies were conducted in Khartoum state, Sudan, with the following aims: (I) To investigate the association between FGM and primary infertility. (II) To assess whether the extent of FGM influences the risk of acquiring STIs. (III) To estimate the prevalence of FGM and the types performed in girls aged 4-9 years in Khartoum and to investigate whether FGM is associated with various social factors. (IV) To assess the reliability of self-reported form of FGM in Sudan and to compare the extent of cutting verified by clinical examination with the corresponding WHO classification. (V) To investigate the possible association between FGM and chronic kidney disease (CKD).

Methods: A detailed history was obtained from respondents in all these studies using structured questionnaires and clinical examination was performed, including genital inspection. In study (I) 99 women with primary infertility were recruited after exclusion of hormonal and iatrogenic causes as well as male factors. Controls were 180 women recruited from antenatal clinic attendees. For study (II) blood samples were taken from 222 respondents of study I, and tested for seropositivity of *Chlamydia trachomatis*, *Neisseria gonorrhoeae* or *Treponema pallidum*. In study (III) 255 consecutive girls aged 4-9 years presenting to the emergency room were recruited. The 282 women from study (I) and the 255 girls from study (III) were included in study (IV). For study (V), 50 consecutive cases, girls aged 4-16 years with known CKD were recruited (known syndromes or congenital malformations were excluded) and 129 age matched controls with no urogenital symptoms.

Results: Women with primary infertility had a higher risk of previous exposure to the most extensive form of FGM (OR 4.69, 95% CI 1.49–19.7). There was no association between serological evidence of STIs and extent of FGM. The only factor that significantly differed between cases and controls was education; cases with STIs having shorter education ($p = 0.03$). Among girls, 40% had undergone FGM with a large share intending to perform it, predicting a future prevalence of 70%. Of those who had undergone FGM 66% had type III. Those who had allowed or intended to allow their daughters to undergo FGM were of lower socio-economic status ($p=0.0008$) and had spent fewer years in school than those who had not (mothers $p=0.0015$). The reliability of reported form of FGM was low and there was considerable under-reporting. Of those who said they had undergone the “*Sunna*” form, 9 girls (39%) and 19 women (54%) had WHO type III. Girls with CKD seem to have undergone FGM more often than controls (OR 2.3, $p = 0.02$, CI 1.9-5.8), and they have longer time interval since FGM was performed ($p = 0.003$). Reporting subjective symptoms of UTI was more common among cases (95%, 47/49, $p = 0.02$), than controls (35%, 45/129).

Conclusion: This study indicates high prevalence of FGM in Khartoum, with type III being the most prevalent form. Parental education, socio-economic level and religion are important determinants of the practice. The reliability of reported form of FGM was low and more importantly there was a considerable over reporting of the “*Sunna*” form. The possible relation between CKD and FGM is not just clinically important but has wider social implications. The observed association between FGM and infertility is intriguing in a society where childbearing is highly valuable.

LIST OF PUBLICATIONS

This thesis is based on the following papers:

- I. Almroth L, Elmusharaf S, El Hadi N, Obeid A, El Sheikh MA, Elfadil SM, et al. Primary infertility after genital mutilation in girlhood in Sudan: a case control study. *Lancet* 2005;366:385-91.
- II. Elmusharaf S, Elkhidir I, Hoffman S, Almroth L. A case-control study on the association between female genital mutilation and sexually transmitted infections in Sudan. *BJOG*. 2006 Apr;113(4):469-74.
- III. Satti A, Elmusharaf S, Bedri H, Idris T, Hashim MS, Suliman GI, Almroth L. Prevalence and determinants of the practice of genital mutilation of girls in Khartoum, Sudan. *Ann Trop Paediatr*. 2006 Dec;26(4):303-10.
- IV. Elmusharaf S, Elhadi N, Almroth L. Reliability of self reported form of female genital mutilation and WHO classification: cross sectional study. *BMJ*. 2006 Jul 15;333(7559).
- V. Elmusharaf S, Abdelraheem M, Abdelrahman I, Hassan EG, Almroth L. A case control study on the association between chronic kidney disease and female genital mutilation. Submitted

CONTENTS

1	Introduction.....	1
1.1	Female genital mutilation	1
1.1.1	<i>Definition</i>	1
1.1.2	<i>Terminology</i>	3
1.1.3	<i>Epidemiology</i>	4
1.1.4	<i>Motives for the practice</i>	6
1.1.5	<i>FGM and religion</i>	6
1.2	Previous research about female genital mutilation	7
1.2.1	<i>The reliability of reported forms</i>	7
1.2.2	<i>Health complications</i>	7
1.3	Female genital mutilation in Sudan.....	8
1.3.1	<i>Legislation in Sudan</i>	10
1.3.2	<i>Activities to end the practice in Sudan</i>	10
1.4	Infertility	12
1.4.1	<i>Causes and evaluation of primary infertility</i>	13
1.4.2	<i>FGM and infertility</i>	14
1.5	Sexually transmitted infections	15
1.5.1	<i>FGM and sexually transmitted infections</i>	16
1.6	Urinary tract and renal complications of FGM on the girl child.....	16
1.6.1	<i>Urinary tract infection</i>	16
1.6.2	<i>FGM and UTI</i>	17
1.6.3	<i>Chronic kidney disease</i>	18
2	Rationale for the studies	20
3	Aims and objectives	22
3.1	General aim	22
3.2	Specific objectives	22
4	Ethics.....	23
5	Setting	26
5.1	Sudan.....	26
5.2	The hospitals	27
6	Participants and methods.....	29
6.1	Paper I and Paper II	30
6.1.1	<i>Patients</i>	30
6.1.2	<i>Data collection</i>	31
6.1.3	<i>Statistical analysis</i>	31
6.2	Paper III.....	32
6.2.1	<i>Patients</i>	32
6.2.2	<i>Data collection</i>	33
6.2.3	<i>Statistical analysis</i>	33
6.3	Paper IV	33
6.3.1	<i>Patients</i>	33
6.3.2	<i>Data collection</i>	33
6.3.3	<i>Statistical analysis</i>	34
6.4	Paper V.....	34
6.4.1	<i>Patients</i>	34

	6.4.2	<i>Data collection</i>	35
	6.4.3	<i>Statistical analysis</i>	35
7	Results	37
	7.1	Paper I.....	37
	7.1.1	<i>Social characteristic of respondents</i>	37
	7.1.2	<i>Forms of FGM and reported complication</i>	38
	7.1.3	<i>Factors related to infertility</i>	39
	7.2	Paper II.....	41
	7.2.1	<i>The study population</i>	41
	7.2.2	<i>The seroprevalence in relation to the practice</i>	41
	7.2.3	<i>Seroprevalance in relation to social characteristics of respondents</i>	43
	7.3	Paper III	43
	7.3.1	<i>Patients and presenting complaints</i>	43
	7.3.2	<i>The practice</i>	44
	7.3.3	<i>The Determinants</i>	45
	7.4	Paper IV	47
	7.4.1	<i>Study population</i>	47
	7.4.2	<i>Anatomical features of different forms of FGM</i>	47
	7.5	Paper V	50
	7.5.1	<i>Social characteristics of respondents</i>	50
	7.5.2	<i>Forms of FGM</i>	51
	7.5.3	<i>Factors related to kidney disease</i>	52
8	Discussion.....		54
	8.1	Methodological considerations	54
	8.1.1	<i>Data collection (Internal validity)</i>	54
	8.1.2	<i>Generalizability (External validity)</i>	54
	8.1.3	<i>Recall bias</i>	55
	8.1.4	<i>Observer bias</i>	56
	8.1.5	<i>Other limitations</i>	56
	8.2	The practice	57
	8.2.1	<i>The determinants</i>	58
	8.2.2	<i>The reliability of reported form</i>	59
	8.3	Health consequences of genital mutilation on the girl child	61
	8.3.1	<i>Short term sequaleae; urinary and renal complications</i>	61
	8.3.2	<i>Sequalae later in life; sexually transmitted infections and primary infertility</i>	63
9	Conclusion		67
10	Recommendations for further research.....		69
11	Acknowledgements		70
12	References		72
13	Appendix		81

LIST OF ABBREVIATIONS

CAPD	Continuous Ambulatory Peritoneal Dialysis
CI	Confidence Interval
CKD	Chronic Kidney Disease
DHS	Demographic and Health Survey
EIA	Enzyme Immunoassay
FGC	Female Genital Cutting
FGM	Female Genital Mutilation
GAT	Gonococcal Antibody Test
GFR	Glomerular Filtration Rate
HIV	Human Immunodeficiency Virus
HSG	Hysterosalpingography
HSV	Herpes Simplex Virus
HyCoSy	Hysterosalpingo-Contrast Sonography
MARP	Million Age Related Population
MICS	Multiple Index Cluster Survey
MR-HSG	Magnetic Resonant Hysterosalpingography
NCCW	National Council on Child Welfare
OR	Odds Ratio
PID	Pelvic Inflammatory Disease
RI	Re-Infibulation
SD	Standard Deviation
SHHS	Sudan House-Hold Health Survey
STI	Sexually Transmitted Infections
SVCP	Sudan Village Concept Project
TBA	Traditional Birth Attendant
TPHA	Treponema Pallidum Heamagglutination Assay
UNFPA	United Nations Population Fund
UNCEF	United Nations Children's Fund
USD	United States Dollar
UTI	Urinary Tract Infection
WHO	World Health Organization

Glossary

Infibulation: Excision of part of the external genitalia and stitching of the vulvo-vaginal opening.

Deinfibulation: Opening of the vulvo-vaginal opening to open the infibulated genitalia.

Reinfibulation: Stitching of the vulvo-vaginal opening to close it after defibulation and delivery.

Medicalization: Situations in which FGM is practiced by any category of health care provider, whether in a public or private clinic, at home, or elsewhere. It also includes the surgical procedure of Reinfibulation at any time in a woman's life.

Reliability: Is the degree to which an assessment tool produces stable and consistent results.

Validity: Refers to how well a test measure what it is purported to measure.

Preface

Sudan Village Concept Project (SVCP) was a student run international project funded by the Swedish International Development Agency - Sida/Sarec in rural central Sudan. The main objectives of the project were to improve the living standards of the people in the area, and increase public health awareness by addressing a variety of issues including female genital mutilation (FGM), which is one of the prominent social problems affecting women and young girls in Sudan.

As a medical student I was actively involved in the SVCP; it was then I began to realize the magnitude of my country's women suffering as a consequence of FGM. After graduation, I had close encounters with patients enduring acute and chronic complications related to FGM; further convincing me of the need to advance the knowledge base and understanding of FGM and its associated morbidities as a first step in the effort to eliminate this abhorrent practice.

1 INTRODUCTION

Female genital mutilation (FGM) is a common practice in Sudan and remains an important topic medically, socially and politically.

FGM is recognized internationally as a violation of the human rights of girls and women (1,2). It is nearly always carried out on minors and is as such a violation of the rights of children. The practice also violates a person's rights to health, security and physical integrity and the right to life when the procedure results in death (3).

Different elements of culture are seen in societies where female genital mutilation is practiced. In Sudan an elaborate ceremony generally surrounds the procedure. This is usually for girls (infants to 11 years old). A young woman subjected to this procedure emerges marriageable while a younger girl receives gifts of special food and clothes. This ceremonial aspect is disappearing in most ethnic groups (4).

The focus of this thesis is put on the girl child, mainly to explore the prevalence and determinants of FGM and also to identify the existence and types of health complications girls and women experience due to the act of cut or removal of external female genitalia.

1.1 FEMALE GENITAL MUTILATION

1.1.1 *Definition*

Female genital mutilation comprises all procedures that involve partial or total removal of the external female genitalia, or other injury to the female genital organs for non-medical reasons (5).

The age at which FGM is performed varies between different ethnic groups, it ranges from infancy to 15 years (5). In Sudan the most common age group is 4-10 years or even 15 (6). Although in Beja tribe in the east of Sudan it is often performed before the first birth day (7).

Female genital mutilation has been classified in to four types as in Table 1. Although in reality the practice varies widely regionally and locally. Type I describes the partial or total removal of the clitoris, and Type II describes partial or total removal of the clitoris and the labia minora and/or the labia majora. The placement of the labia minora and or the labia majora when cut so that they come into contact is described by Type III. Type IV is the category for other harmful procedures to the female genitalia for non-medical

purposes, piercing or pricking the clitoris, and scraping the inner walls of the vaginal passage (8).

Table 1: The World Health Organization classification of female genital mutilation, complete typology with subdivisions (9)

<ul style="list-style-type: none"> • Type I — Partial or total removal of the clitoris and/or the prepuce (clitoridectomy). 	<ul style="list-style-type: none"> • Type Ia, removal of the clitoral hood or prepuce only; • Type Ib, removal of the clitoris with the prepuce.
<ul style="list-style-type: none"> • Type II — Partial or total removal of the clitoris and the labia minora, with or without excision of the labia majora (excision). 	<ul style="list-style-type: none"> • Type IIa, removal of the labia minora only; • Type IIb, partial or total removal of the clitoris and the labia minora; • Type IIc, partial or total removal of the clitoris, the labia minora and the labia majora.
<ul style="list-style-type: none"> • Type III — Narrowing of the vaginal orifice with creation of a covering seal by cutting and appositioning the labia minora and/or the labia majora, with or without excision of the clitoris (infibulation). 	<ul style="list-style-type: none"> • Type IIIa, removal and apposition of the labia minora; • Type IIIb, removal and apposition of the labia majora.
<ul style="list-style-type: none"> • Type IV — All other harmful procedures to the female genitalia for non-medical purposes, for example: pricking, piercing, incising, scraping and cauterization. 	

FGM Type 1 is commonly called “Sunna” or (gada albazar) in Sudan. The most severe form of FGM, Infibulation, is called “Pharaonic circumcision” in Sudan, (khifad firuni is the Sudanese-Arabic term), and there is also an intermediate form which is a modified less severe form called in Sudan “Mutwasit” (10).

Re-infibulation (RI) is a secondary form, called in Sudan “El adlla”, it has been defined as the re-stitching after delivery of the scar tissue resulting from Infibulation (11,12). Re-infibulation is also described as additional tightening to recreate the narrow vulva of a virgin, performed on previously infibulated women who have given birth, widow or divorced (13–16).

Deinfibulation is splitting of the vulvar scar after infibulation to widen the vaginal orifice. This is usually performed during labour, occasionally after marriage in situation of failed or difficult penetration. Many women undergo RI without prior

deinfibulation, for instance after caesarean section, but also regularly without connection to delivery (11).

It is important to distinguish the RI from episiotomy repair, which is done after delivery to reconstruct a normal vulvar anatomy. In 1982 Eldareer estimated that about 50% of Sudanese women underwent RI one or more times post-partum (17). In 2004 a study showed 61% prevalence of tightening operations of the vulva after delivery in two hospital settings in Sudan (14). The same study identified various motives for Re-infibulation, social pressure being the most important and for the sake of the husband satisfaction.

1.1.2 Terminology

The terminology used to describe the practice has been a subject of ongoing debate. The term female circumcision has been used historically in the communities that practice it, although it causes confusion because it tends to equate with the male circumcision. The male circumcision involves the removal of the foreskin, or prepuce, from the penis. This act is performed for reasons of religion, hygiene, personal preferences possibly driven by societal norms or for medical reasons. However, the extent of cutting in what is commonly referred to as “*female circumcision*” is anatomically more extensive than in male circumcision. Anatomically, the male equivalent of clitoridectomy performed on females would be the amputation of most of the penis, and that the male equivalent of infibulation of females would be the removal of all of the penis, its roots of soft tissue, and part of the scrotal skin (18).

Female genital mutilation was the term adopted by the World Health Organization (WHO) and United Nations agencies as the harm caused by the practice became more recognized. It was adopted in 1990 by the Inter African Committee on Traditional Practices Affecting the Health of Women and Children, and in 1991 the WHO recommended that the United Nations adopt it as well. However, objections have been raised as the term FGM has been found to be offensive and shocking to women and practicing communities who do not consider the practice as mutilation (19).

Female genital cutting (FGC) is used more and more in an effort to use a term that is value neutral, non-judgmental, sensitive, and respectful and on the other hand describe the nature of the practice. However, some argue that the term “*cutting*” does not cover all forms of FGM, as in the case of when there is appositioning, or bringing of the two sides of the labia minora or majora together.

Currently UNICEF and UNFPA use ‘female genital mutilation/cutting’ or FGM/C. This is meant to capture the significance of the term ‘mutilation’ at the policy level and highlight that the practice is a violation of the rights of girls and women. At the same time, it recognizes the importance of employing respectful terminology when working with practicing communities (19).

Practicing communities use a variety of names to describe the practice. On data collection we used several local terms as “*Khifad*” and “*Tahur*” for the practice and “*Sunna*” for clitoridectomy, “*Pharoni*” for Infibulation.

The term “*female genital mutilation*” is used throughout this thesis.

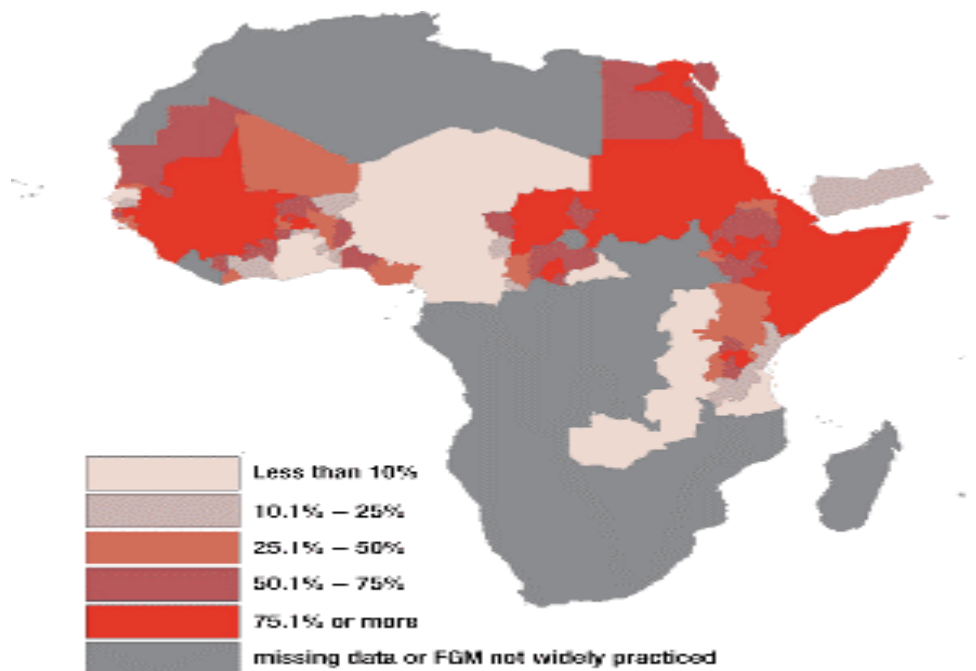
1.1.3 Epidemiology

True worldwide prevalence rates of FGM are unknown because of the variable quality of informants, inconsistent reporting, and poor documentation. Prevalence rates of FGM in immigrant populations living in industrialized countries are also unavailable. Thus, prevalence rates reported in the medical literature vary widely (20).

Worldwide about 140 million girls and women are currently living with the consequences of FGM. The WHO estimates that annually three million girls in sub Saharan Africa, Egypt and Sudan continues to be at risk to be subjected to the practice. In Africa an estimated 101 million girls 10 years old and above have undergone FGM (5).

Genital mutilation is practiced on girls and women in more than 30 countries (Figure 1), mainly in Northeast Africa, but also in some areas in western Africa, in southern parts of the Arabian peninsula, along the Persian Gulf, among Iraqi Kurds and among some migrants from these areas (5,21,22). Although nationally representative data on FGM are lacking for countries including Colombia, Jordan, Oman, Saudi Arabia and parts of Indonesia and Malaysia, evidence suggests that the procedure is being performed (23–26).

Figure 1: Prevalence of female genital mutilation in Africa and Yemen (women aged 15 - 49)



Source: MICS, DHS and other national surveys, 1997-2006. Map developed by UNICEF, 2007

Some studies show that the prevalence of FGM globally is slowly decreasing. A new indicator in surveys of national prevalence measures the extent of cutting among daughters aged 0 to 14, as reported by their mothers, shows that fewer daughters are cut compared to their mothers (27). It is important to note that these prevalence data for girls reflect their current; not final FGM status, since many of them may not have reached the customary age for cutting at the time of the survey, and need to be interpreted with caution.

Changes in the practice have been noted in certain countries, these include a shift from infibulations to less invasive types of FGM, performance of the procedure at a much earlier age, reduction of the ceremonial aspect of the practice, and medicalization of the practice (28). Recent data suggest that the medicalization of the practice, mainly through the act of Re-infibulation, is also a concern in countries that receive migrants from countries where FGM have been documented.

In the majority of countries, FGM is usually performed by traditional practitioners and, more specifically, by traditional circumcisers, traditional birth attendants or midwives. However, the trend of health care providers performing FGM is increasing (5). In some countries, such as Egypt, Sudan and Kenya, however, a substantial number of health-care providers perform the procedure. This phenomenon is most acute in Egypt, where doctors rather than other health professions perform FGM more commonly (29). Mothers report that in three out of four cases (77 per cent), FGM was performed on their daughters by a trained medical professional. In Sudan FGM is usually performed by traditional birth attendants and trained midwives but there are some female gynecologists who perform it.

1.1.4 Motives for the practice

Female genital mutilation is a very sensitive and complex subject. FGM is often deemed necessary in order for a girl to be considered a complete woman. If mutilation is part of an initiation rite, then it is accompanied by explicit teaching about the woman's role in her society.

There are several reasons provided to justify the practice of female genital mutilation. The reasons for the practice in Sudan do not differ from those in neighboring countries. Virginity is a pre-requisite for marriage and is equated to female honour in a lot of communities. FGM, in particular infibulation, is defended in this context as it is assumed to reduce a woman's sexual desire and thereby preserving a girl's virginity (12,30–33). The tight introitus created by Infibulation and Re-Infibulation is believed to increase the sexual satisfaction for men (34). Female identity, hygiene, religion, social custom, tradition and increased fertility or future marriage are often used as motives for the practice (10,12,33,35).

1.1.5 FGM and religion

Religious reasons are often mentioned and sometimes misused by pro FGM groups to sustain the practice. In countries where FGM is practiced, it is practiced by community members who are Muslims, Christians, Jews and non-believers (36). In spite of the fact that FGM predates Islam as well as Christianity and Judaism (13,17,37), Muslims who practice FGM rationalize it as a Muslim religious obligation.

All religions say God created human beings in the best forms and wanted them to keep the nature in which they were created. In Islam, it is forbidden to make changes in God's creation unless there is a compelling reason.

A number of Islamic scholars have issued various Islamic Fatwa on the issue of FGM most of which have disassociated FGM from Islam quoting both *Quran* as well as *Hadith* and showing that all FGM related (*Hadith*) that are allegedly attributed to Prophet Muhammad {Peace Be Upon Him} have been proved to be inauthentic (38).

1.2 PREVIOUS RESEARCH ABOUT FEMALE GENITAL MUTILATION

The precise incidence of complications secondary to FGM is unknown. Studies on FGM described in the literature derive mainly from data reported by adult women. There are only few studies on the primary victim, the girl child.

1.2.1 The reliability of reported forms

Almost all studies in Sudan and worldwide about prevalence and trends of FGM are based on women reporting their form of FGM, in particular DHS and MICS studies. It is not known how this reported form corresponds to reality. There are relatively few studies which provide information on self-reports and clinical information on FGM status (39–41). In rural Gambia there was a high level of agreement (97%), in a community based study, between reported FGM-status and that found on examination (39). A study from Nigeria showed that the validity was low (42). Evidence suggest that there can be an extensive under reporting of forms of FGM (43).

The reliability of reported forms of FGM, and what the local terms used correspond to in anatomical terms, is a very important issue which one has to be aware of especially since prevalence and trends in studies are most often based on interviews. There are, apart from our study, no studies investigating this relation in Sudan.

1.2.2 Health complications of FGM

Complications of FGM have not been well elucidated in research. The immediate complications described in the literature, however, derive mainly from data reported by adult women. Theoretically, FGM, by cuts in the relatively big clitoral artery and the richly innervated vulvar area, and because of the unsterile conditions in which the procedure is often performed, is associated with an increased risk for both acute and long-term complications.

The physical and psychological health risk of FGM that have been reported include infections, such as cellulitis, clostridia gangrene, tetanus, and sepsis (44). Other acute complications include severe pain, haemorrhage, fractures, acute urinary retention, and even death (45).

Psychological and sexual consequences include among others post-traumatic stress, fear and anxiety at marriage time and dyspareunia (46,47).

Long term complication include menstrual problems, sexual dysfunction, infertility, infected epidermal inclusion cysts, abscess formation, chronic pelvic infections, keloid formation, haematocolpos, and increased risk of obstetric complications (44,46,48–51). A recent study in Sudan showed a significant association between cervical cancer and FGM (52). Also women who have undergone Type III FGM have increased risk of anal sphincter tear during labour even when delivering in a highly technical quality health care system (53). A recent study in Sierra Leone showed that fever was significantly more often reported by girls who had undergone FGM before 10 years of age (54).

1.3 FEMALE GENITAL MUTILATION IN SUDAN

Sudan is one of the countries where the practice of female genital mutilation is widespread. The uncertainty of prevalence rate noted globally due to the variable quality of informants, inconsistent reporting, and poor documentation is also noted in Sudan. According to UNICEF's recent global database based on DHS, MICS and other national surveys 1997-2011, published in 2013, Sudan ranks eighth among the countries that practice FGM, with a prevalence rate of 88% (29). The same prevalence rate was reported by a recent study in eastern Sudan (55). However, the first Sudan Household Health Survey in 2006 showed a prevalence rate of 69%, and 66% in the most recent one in 2010. The contradiction in the two prevalence estimates published almost in the same year, shows the doubtfulness and lack of reliability concerning the epidemiology of FGM both in Sudan and worldwide. There is a great variation inside Sudan: prevalence rates varying between 40% in West Darfur and 84% in River Nile state, type of FGM performed also exhibit regional variability. In some areas almost all women have undergone the most severe form of FGM, other areas show a very low prevalence or only milder forms (10,56). The practice is not common in the southern states but there are no prevalence estimates available. The Sudan Household Health Survey (SHHS) in 2006 shows 70% prevalence of FGM in Khartoum. This might indicate an important trend since, according to community-based data, the prevalence

of FGM in Khartoum was 78.7% in 1999 and the DHS in 1989/1990 demonstrated a prevalence of FGM in Khartoum of 96% (32,56,57). Figures 2 a and b show the change in FGM prevalence in Sudan and Khartoum respectively.

Figure 2a: The change in FGM prevalence in Sudan 1977-2010

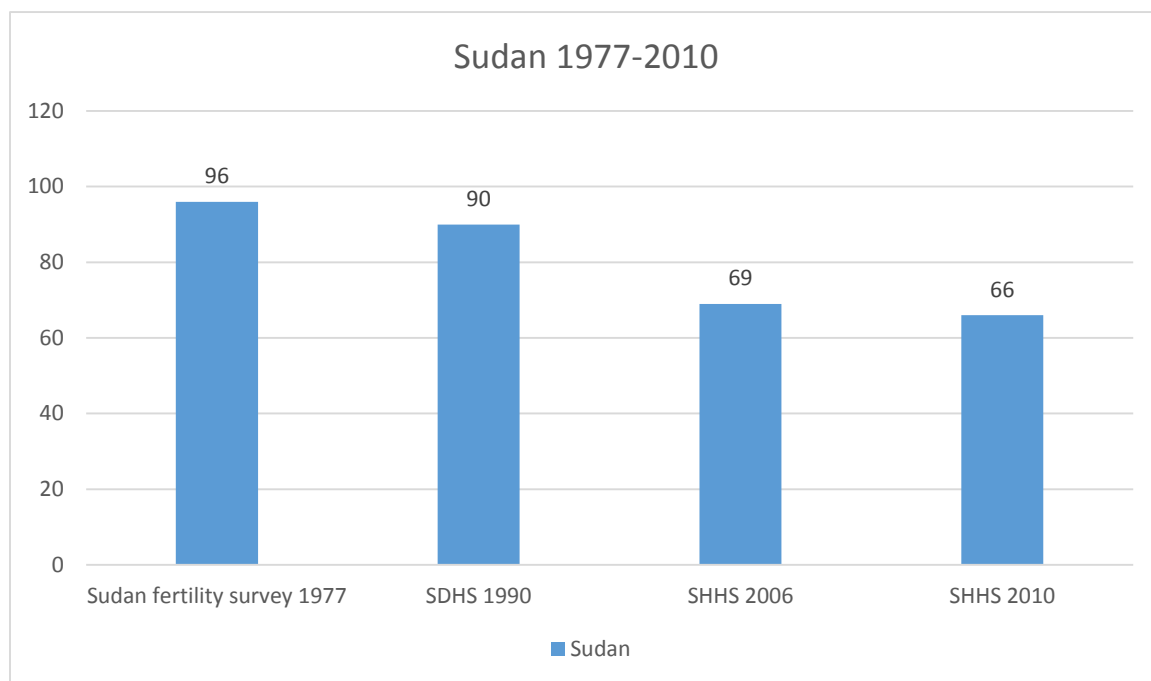
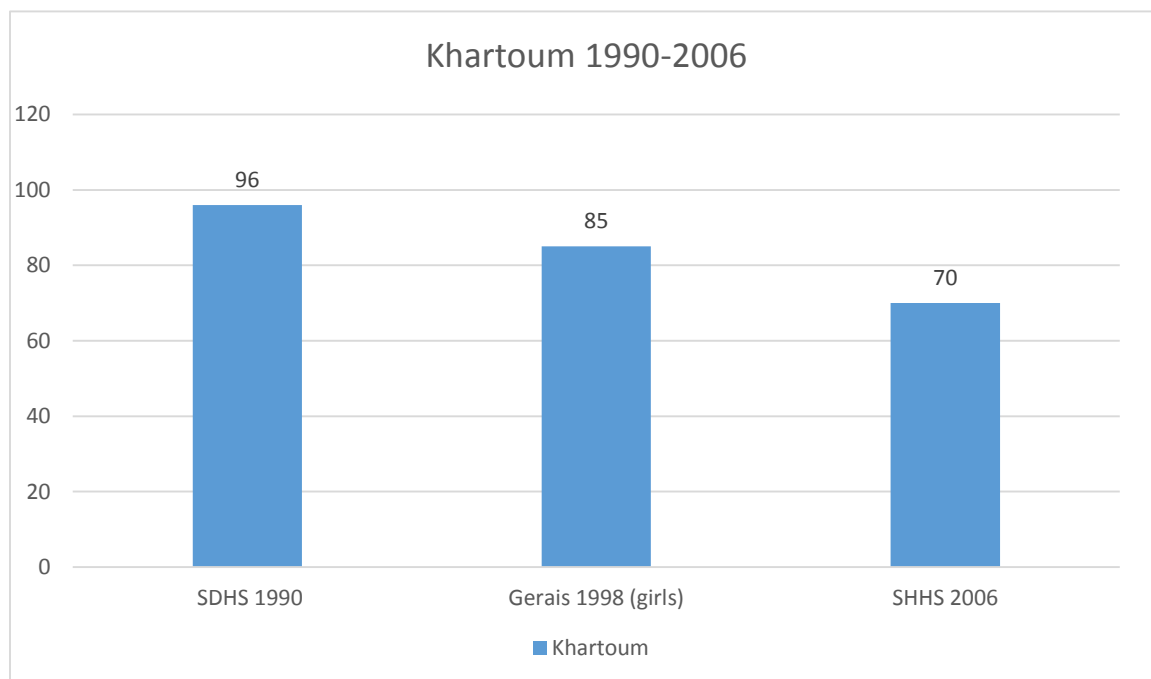


Figure 2b: The change in FGM prevalence in Khartoum 1990-2006



1.3.1 Legislation in Sudan

FGM was declared illegal in Sudan in the early 1940s, but the practice has continued with little interruption. Sudan was the first African country to introduce legislation against female genital mutilation. This happened in 1946, when infibulation was prohibited through a Supplement to the penal code. Less severe procedures were permitted. The law was upheld in 1957 as Sudan gained its independence, and provided for a fine and/or imprisonment up to seven years for practitioners of infibulation. In 1974, the maximum sentence was reduced to five years (7). The current penal code, however, does not cover genital mutilation, although its Provisions on “physical injury” might potentially cover genital mutilation (4). The authorities issued a decree in 2003, outlining that health personnel were not permitted to perform genital mutilation. Nor are they allowed to perform Re-infibulation. However, lack of statutory prohibition makes it difficult to bring matters before the courts.

Research into the phenomena of genital mutilation in Sudan has a long tradition (58). Sudanese doctors have been involved in research and study efforts since the 1960s, but it was not until the 1970s that anti-FGM activities gathered strength. Towards the end of the 1970s, both the Sudan Family Planning Association and the Sudan Society of Obstetrics and Gynaecology adopted recommendations with a view to abolishing genital mutilation.

In February 2009 the Sudanese government legalized the “Sunna” form of FGM. The Council of Ministers dropped the 13th article of the 2009 Children’s Act which banned FGM to take into account the fatwa that distinguishes “harmful” circumcision from “Sunna”. This decision came just one day before the world celebrated International Day of Zero Tolerance of Female Genital Mutilation. With this decision, Sudan has taken decades of work against this practice back to square one.

Following this, as Sudan is using the federal system, states are allowed to have their own legislations and formulate their own Child Acts. Two of the states have ratified Child Acts with an article banning FGM. Child acts is pending ratification in two other states. In states where laws were passed, there is still the challenge of implementing these laws and translating them on the ground.

1.3.2 Activities to end the practice in Sudan

Currently there is a number of governmental and voluntary organizations working towards the elimination of FGM, but despite these long term efforts, FGM continues to be widespread in Sudan. Whereas a few positive changes have been observed, these

relate primarily to a transition from infibulation to clitoridectomy (33), and not eradication.

Sudan's National Council on Child Welfare (NCCW) and its National Strategic Planning Centre came up with a new strategy to spur collective behavioral change within communities. They encouraged the use of the word *Saleema* – an Arabic woman's name that means whole, intact, and healthy in body and mind, unharmed, pristine, and untouched, in a God-given perfect condition – to replace the negatively charged "*ghalfa*" the word that is used in Sudanese slang for uncircumcised woman. "*Ghalfa*" carries connotations of impurity, promiscuity, even prostitution. The strategy aims to nurture a new social norm by reinforcing the idea that being uncut is a natural, desirable state, rather than trying to discredit a long-held tradition.

Beginning in 2008, local activists and members of the media in all of Sudan were trained to explain the consequences of FGM, and community networks were established to conduct the nationwide campaign, which was officially launched in January 2010.

At federal and state levels, media campaigns were promoted. The "*Saleema*" message is carefully positioned and branded in the local culture through song, poetry and TV animations, all imbued with a specific palette of colours – mainly orange, red, yellow and green.

In early 2011 the Khartoum State Ministry of Health, in collaboration with the NCCW and UNICEF, launched a program called "*Born Saleema*" to apply the "*Saleema*" approach directly to protecting new born baby girls. Women who give birth to girls in each of three public maternity hospitals and six health centers are registered and visited by trained health workers who explain the *Saleema* philosophy – "Every girl is born *Saleema*; let her grow up *Saleema*." Counselling about the benefits of *Saleema* is provided to parents and family members and the family is invited to join the campaign.

"Saleema Ambassadors" is another innovative facet of the "*Saleema*" campaign. In it, 10 public figures and local celebrities (men and women) each make 10 public appearances – sometimes on national or state television – wearing the *Saleema* colours and talking about their commitment to "*Saleema*". Rather than instructing audiences on what they should or should not do with respect to FGM, the Ambassadors simply tell their personal stories about how they came to embrace the "*Saleema*" idea.

The campaign have been ramping up recently with extensive media outreach. It has, however, been criticized by activists in Sudan for not mentioning the term FGM.

Currently, UNFPA and UNICEF have a joint program that aims at reducing FGM by at least 40% by the year 2015 in 17 countries, including Sudan. The program was launched in 2007 and promotes a human rights-based approach to encourage communities to act collectively to abandon the practice. This approach has resulted in public declarations against FGM by 670 communities across Sudan.

1.4 INFERTILITY

Infertility, the inability of a couple to conceive, is a major medical condition that affects many married couple in Africa. It should be distinguished from other causes of childlessness such as miscarriages and child loss. Primary infertility refers to a couple who have never conceived, while secondary infertility refers to a couple who have previously achieved conception at least once but are unable to repeat it.

The main challenges in generating global estimates of infertility are the scarcity of population-based studies and the inconsistent definitions used in the few high-quality studies available (59,60). Infertility has been defined as failure to conceive after one year of regular unprotected sexual intercourse in the absence of known reproductive pathology (61). However, epidemiological studies have revealed that in a normal population of heterosexually active women who are not using birth control methods, 25% will become pregnant in the first month, 63% within 6 months, and 80% within one year. By the end of a second year, 85% to 90% will have conceived (62). So sometimes two years is used to define infertility.

Around 10-15% of couples worldwide are infertile according to the one-year definition (63) . In Africa the number varies from 10 % to as much as one third in some areas (64–67). While primary infertility is the dominating problem in other parts of the world, secondary infertility is the main problem in Africa (64,66,68,69). Higher prevalence of sexually transmitted infections (STIs) and non-hygienic obstetric or abortion practices in Africa probably accounts for this difference (68,70). WHO demographic studies from 2004 have shown that in sub-Saharan Africa, more than 30% of women aged 25–49 suffer from secondary infertility (71)

Infertility is currently becoming more of a burden in Sudanese society mainly because both men and women are marrying at an older age during the current difficult financial and socio-economic circumstances. Now women are having shorter reproductive

periods and men want to ensure that they, as a couple, can procreate as they are unlikely to remarry.

There is a clear lack of infertility statistics in Sudan. Studies, in settings similar to African countries, showed the main cause of infertility among females is tubal factor due to chronic infections (post-partum infection, PIDs and STIs) (72). Previous studies have shown that primary infertility is estimated to be 3–5% in Sudan, and secondary infertility around 9-16% (64). Recent studies show different pattern of infertility in Central Sudan. One study in Central Sudan showed that primary infertility was more prevalent than secondary infertility (79.5% and 20.5% respectively) (73). Another study also showed that primary infertility is the dominant type of infertility (69).

The underlying cause of infertility may be a male factor, found to account for 40% of cases, female factor (40%) or combination (20%) (63,74). Studies from Sudan have shown that male factor infertility constitutes a third of infertility cases (69,75). Another study in Sudan states that about 36% of infertility was due to male factor, 49% due to female factor, 1.5% was combination male and female factors while 13% was unexplained (69).

In spite of these statistics, available evidence indicates that women disproportionately suffer the social and psychological consequences of infertility in Africa as compared to men (76).

1.4.1 Causes and evaluation of primary infertility

Ovulatory disorders are one of the most common reasons why women are unable to conceive (69). Many factors can affect ovulation, such as hypothalamic disorders and hyperprolactinaemia and also by thyroid dysfunction and diabetes mellitus. Polycystic ovary syndrome (the most common disorder causing anovulation), diminished ovarian reserve and premature ovarian failure are ovarian disorders that can cause infertility.

Tobacco smoking, body weight, eating disorders and iatrogenic causes (chemotherapy and radiation) all contribute to the problem of infertility, as well as excessive exercising, alcohol drinking and older age (77–79).

Tubal factors which accounts for 10-15% of infertility in all women, is a common cause in developing countries (66,68,80), even in the absence of ovulation disorders, ranging from adhesions to complete tubal blockage. Use of intrauterine devices, previous abdominal surgeries and abdominal disease suggest a predisposition to

adhesion formation and increase the likelihood of tubal dysfunction (63). In rare cases, women may be born with tubal abnormalities, usually associated with uterus irregularities. By far the most common cause of tubal pathology is a sequelae of infections by chlamydia trachomatis and less frequently by Neisseria Gonorrhoea. These infections are usually asymptomatic and remain untreated. In a woman untreated infection can lead to PID and at a later stage to ectopic pregnancy or tubal factor infertility (81,82).

Hysterosalpingography (HSG) is usually performed to assess tubal patency. HSG has been found to give high false positives and negatives (63). Laparoscopy combined with HSG is more effective method to reveal tubal blocks. However recent studies show, that hysterosalpingo-contrast sonography (HyCoSy) is a cost effective screening test as compared to diagnostic laparoscopy with HSG in the assessment of tubal patency for the investigations of infertility patients (83,84). This procedure however will not provide information about other adnexal abnormalities. It is considered as a preliminary screening procedure at the early stage in tubal investigations (84). MR-HSG is a new promising imaging approach to female infertility, MR-HSG is useful and well tolerated tool for the assessment of the uterus, fallopian tubes, ovaries and extra-uterine structures (85).

1.4.2 FGM and infertility

In societies where FGM is traditionally practiced, women are taught from childhood that womanhood is tied to motherhood, thus infertility strongly impacts women's social status within the community when women cannot speak of their experiences of pregnancy, labour, delivery and parenting, they are often excluded from adult conversations (86). Enhance marriageability, prove virginity and also fertility are often quoted as motives to perform FGM (33,87). In many societies there is a strong belief that FGM, in particular clitoridectomy, enhance fertility by making the young girl less masculine (87).

The genital tissue damage provoked by FGM, with its inherent microbial contamination, creates a risk of vaginal infections. Lack of labial fat pads and pubic hair; small labia minora; thin and delicate vulvar skin; and thin, atrophic, anestrogenic vaginal mucosa are factors that may increase susceptibility to bacterial infection in a young girl (88,89). Such infections can be expected to thrive in the pre-pubertal girl's

lack of vaginal acidity (88,90). The blockage of urine caused by labial adhesions has been found to cause vulvovaginitis as well as urinary tract infections (91). In severe forms of FGM there is only a narrow opening for the passage of urine, similar to the blockage caused by labial adhesions. Thus, there is reason to believe FGM may also lead to urinary tract infections (UTIs) and vulvovaginitis. In the absence of a protective environment, the infection might ascend to reach the uterus and the fallopian tubes, with risk of ensuing tubal damage and impaired fertility.

In addition micro-organisms from the lower genital tract (vulvovaginitis) can spread to cause cervicitis, which leads to change in cervical mucus pH this may affect the motility of sperm. In theory FGM may cause infertility in this way as well (63).

FGM has often been said to cause infertility, but until our study was published there was little scientific support for this.

1.5 SEXUALLY TRANSMITTED INFECTIONS

Sexually transmitted infections are infections that are spread primarily through person-to-person sexual contact. HIV and syphilis can also be transmitted from mother to child during pregnancy and childbirth, and through blood products and tissue transfer. STIs are caused by bacteria, viruses and parasites.

STIs are an important public health problem worldwide, and have a major negative impact on sexual and reproductive health. Untreated STIs can have critical implications for reproductive, maternal and new-born health.

In developing countries, STIs and their complications rank in the top five disease categories for which adults seek health care (92).

Globally, according to WHO estimates, 499 million new cases of curable sexually transmitted infections (Syphilis, Gonorrhoea, Chlamydia and Trichomoniasis) occur annually in adults' age 15- 49 years. These figures do not include the additional health burden caused by HIV and other viral STIs such as HSV (92). STIs can increase the risk of HIV acquisition three-fold or more (92).

STIs are an important preventable cause of infertility for men and women. Ten to 15% of women with untreated chlamydial infection may develop symptomatic pelvic inflammatory disease (PID), and about 10–15% of clinical PID cases lead to tubal factor infertility (92). There is evidence that a large proportion of infertility, reportedly up to 46% in Africa, is related to infections that cause damage to the genital tract. STIs especially, cause a high over all burden, particularly in sub Saharan Africa (93). Untreated infections can lead to severe reproductive complications in a society where

children are highly valued for traditional and economic reasons. Childlessness is a feared condition. The diagnosis and treatment of STIs in low-income countries are hampered by lack of facilities. STIs, especially those causing genital ulcer have been shown to enhance HIV transmission (94).

Previous studies in Africa have shown a high prevalence of STIs. In South Africa the prevalence of syphilis is 6-7%, and in Tanzania 2.5%. In Mozambique TPHA seropositivity occurred in 55% of infertile women and 18% of fertile women in a study done in the northern part of the country. Another study from Mozambique shows a rate of Gonorrhoea seropositivity of 76% of infertile women. In Ethiopia 59% of women attending gynaecological Outpatient clinics, obstetrics and family planning clinics were positive. These studies show that being infertile increases the risk of acquiring sexually transmitted infections mainly by increasing polygamy and extramarital affairs. (94–97). There are only vague figures and estimates about the prevalence of STIs in Sudan. A study in Sudan has shown a high (7.8%) sero-prevalence of *Chlamydia trachomatis* in antenatal attendees (98).

1.5.1 FGM and sexually transmitted infections

FGM carries the risk of a number of complications, but still little is known about the relation of this practice and sexually transmitted infections. Pelvic inflammatory disease seems to be one of the complications of FGM (99). A study in Sudan indicated that the incidence of PID in patients with type III was more than three times higher than in patients with type I (100). A study among women attending family planning and antenatal care clinics at three hospitals in Nigeria has shown that women with FGM were significantly more likely to have experienced repeated symptoms of reproductive tract infections (99).

To our knowledge, there has, however, not been any study prior to our study relating FGM to chlamydia, gonorrhoea, or syphilis.

1.6 URINARY TRACT AND RENAL COMPLICATIONS OF FGM ON THE GIRL CHILD

1.6.1 Urinary tract infection

UTI is the commonest bacterial infection in childhood which merits special attention as it has been considered a risk factor for the development of renal insufficiency and end stage renal disease. Therefore, early detection and therapy are needed to prevent

scarring and further renal damage. Symptoms and signs are nonspecific and the diagnosis of UTI in children require high degree of suspicion (101–103). *Escherichia coli* is the most causative organism, identified in about 85% of infections (103,104).

Traditionally, UTIs have been classified by the site of infection: pyelonephritis (kidney), cystitis (bladder), urethritis (urethra). Recurrent UTI is defined when one of following criteria is fulfilled (102): Two or more episodes of UTI with acute pyelonephritis or one episode of UTI with acute pyelonephritis plus one or more episode of UTI with cystitis/lower urinary tract infection or three or more episodes of UTI with cystitis/lower urinary tract infection. Recurrent UTI in girls is associated with renal damage (101).

Certain factors have been identified for risk of recurrence of UTI:

Abnormal micturition habits; Evidence have shown that some children develop the habit of retaining urine in the bladder for long periods because of desire not to interrupt play activities or because fear of previous periods of physical or psychic trauma (91). Over distention of the bladder with resultant circulatory disturbance in the bladder wall is the probable cause for development of infection in this group of children. FGM can cause UTI in this way as well.

Obstructive uropathy; Most of the urinary tract infections observed in children are associated with obstructive lesions of the lower urinary tract. The lesions occurring in the male child have been known and recognized for a relatively long period. In the female child, the most common causes for obstructive uropathy of the lower urinary tract are distal urethral stenosis and stricture of the urethral meatus. Stricture, although rare, can be congenital or acquired. Trauma may cause strictures of the membranous part of the urethra.

Labial adhesions; occurs in about 2% in girls (90). Spontaneous labial adhesion is associated with local inflammation and asymptomatic bacteruria (105).

Vesicourethral reflux is other important predisposing factor for UTI, usually cause pyelonephritis (103).

1.6.2 FGM and UTI

Structural abnormalities of the urinary tract resulting from FGM can predispose a girl to recurrent urinary tract infections. In FGM type III, the urethral meatus may be blocked by the infibulated scar, which can lead to the accumulation of urine and menstrual blood, thereby facilitating the entry of bacteria into the urinary tract, which

will increase the risk of recurrent urinary tract infections and possibly reflux back of urine in to the bladder and kidneys (44)

A study by Dirie et al in 1992 (44), showed that the urethral meatus is frequently sutured or injured during the FGM procedure and also later during subsequent labour and delivery, resulting in meatal obstruction or stricture and periurethral tears, especially in women with FGM type I or type II.

Girls who have undergone FGM may report a slow urinary stream, straining, and urinary retention (48). Previous study from Sudan showed that for girls under the age of 7 there was a significant association between FGM and suspected urinary tract infection, and that symptoms from the urogenital tract in girls were heavily under-reported(106). Labial adhesions and urethral strictures are known risk factors of recurrent UTI. Urethral strictures are rare but iatrogenic trauma such as the FGM procedure could result in strictures and accumulation and reflux back of urine. Theoretically any form of FGM that involves suturing or apposition of the two sides to heal together is similar to labial adhesion as risk factor for a symptomatic bacteruria and recurrent urinary tract infections, which are known risk factors of kidney disease (107).

1.6.3 Chronic kidney disease

Unique to urinary tract infections in children is the increased risk of renal parenchymal injury due to pyelonephritis, progressing to irreversible renal scarring and chronic renal disease as a consequence (90,104).

The true incidence, prevalence and causes of CKD in Sudanese children are difficult to determine, because of the pattern of referral and lack of a national database (108). The paediatric nephrology service was only started in Khartoum in 2001, and, before then, older children were treated in renal centres supervised by adults' nephrologists. All these facilities are centred in the capital, Khartoum, and patients from different parts of the country have to travel to these centres for specialised nephrology care.

There is huge variation in the aetiology of CKD between countries and regions. Genetic factors, environmental and socio-economic differences are possible causes of this difference. The aetiology of CKD in children is different from that in adults. Infections and acquired causes are responsible for most CKD cases in developing countries, where patients are often referred late and at a terminal stage (109,110). Congenital dysplasia/hypoplasia is the most common cause of CKD in the developed world, where early diagnosis is possible (107). In a study from Sudan the cause of CKD could not be

identified in the majority of children because of late referrals and terminal stage at diagnosis. Glomerulonephritis was the most common identifiable cause for CKD in children (108).

To our knowledge, there has not been any previous study investigating the possible association between FGM and chronic kidney disease in girls.

2 RATIONALE FOR THE STUDIES

FGM is a sensitive topic, which needs to be addressed with great care, without affecting people's feelings as it is touching on other people's culture.

The purpose of this research was to investigate the issue of female genital mutilation in Sudan, as one of the biggest social problems affecting the majority of Sudanese women and young girls.

Fertility and future marriageability are very important social aspects in the FGM context. Previous studies have shown that FGM increase the risks of pelvic inflammation which in theory could lead to infertility. In theory, infections that arise after FGM in childhood might ascend to the internal genitalia, causing inflammation and scarring leading to tubal factor infertility. Thus, we decided to investigate the possible association between FGM and primary infertility (paper I).

Sexually transmitted infections is a very sensitive subject in Sudan. . Religious and traditional attitudes limit the knowledge and evidence on STIs in Sudan. The Sudanese are conservative Muslims in general, and it is little wonder that STIs are hardly addressed.

Evidence on the epidemiology of STIs in Sudan and their relation to FGM are very limited, so came the idea of paper II.

There is also a clear lack of studies on the primary victim; the girl child. Thus we decided to probe more in to the prevalence and associated factors of the practice among girls (paper III).

Literature about complication of FGM have been based mainly on self-reports by adult women or case reports. There is a lack of systematic and controlled studies.

Sunna in Islam means in accordance with specific words, habits and silent approval of prophet Mohamed. Type Ia has traditionally been called "Sunna" which has given rise to the confusion and misinterpretation of the relationship between FGM and Islam. FGM is not mentioned in the Quran. Some believe there is a religiously recommended form of FGM, the removal of the clitoral prepuce, which they call Sunna. In practice the removal of only the prepuce in girls is difficult and requires refined surgical skills. In reality it is not performed.

There is a lack of clinical studies to verify the reported form of FGM relating it to the actual extent of anatomical damage to the external genitalia, which is an important

aspect when conducting or interpreting results from epidemiological surveys or studies. Thus we conducted the study on the reliability of reported forms of FGM (paper IV).

In clinical paediatric practice in Sudan, it is very rare to see complications to FGM (unpublished observations). There can be several reasons for this, for instance; reluctance among mothers/family members to seek paediatric/medical care in case of immediate complications after FGM (fever, lower abdominal pain, vaginal discharge etc.). Instead they usually consult the person who performed the operation. Or it can be due to non-recognition of the entity of genital trauma in emergency wards of paediatric outpatients.

Reporting of repeated subjective symptoms of UTIs was common in paper I and paper III, As well as reporting urinary symptoms as immediate complications of FGM. Several studies in the literature support this relation among adult women but little is known among girls. As mentioned above, there is an association between repeated UTIs and CKD in children. Thus the study on the association between CKD and FGM followed (paper V).

Paediatric research findings on complications of FGM might improve the health care provided to girls affected by the practice and help to prevent long term sequelae the girls may face physically, psychologically and also in their reproductive life.

In addition to this, research may reveal findings that can help in campaigns against the practice and challenge the positive value that this ancient practice carries for communities who practice it, especially when these findings interconnect with other socially and culturally important aspects, such as marriageability and religion.

The more we do research about FGM the more we realize that further research is important to understand the negative health effects of the practice and to better argue against the fundamental motives for FGM that kept it still highly prevalent in spite of decades of campaigns to end it.

3 AIMS AND OBJECTIVES

3.1 GENERAL AIM

The overall aim of the thesis was to study the practice of Female Genital Mutilation in Sudan and its effect on reproductive health; to study the health consequences on the girl child, and to explore the prevalence and determinants of FGM and its different forms in Sudan.

3.2 SPECIFIC OBJECTIVES

The specific objectives of the thesis are:

- To investigate the possible association between FGM and primary infertility, (paper I).
- To measure the sero-prevalence of *Chlamydia trachomatis*, *Neisseria gonorrhoea* and *Treponema palladium* and determine their association with extensive form of FGM among fertile and infertile women in Khartoum, (paper II).
- To elucidate prevalence and trends of FGM among girls in Khartoum, and to explore the socio-cultural determinants of FGM among girls in Khartoum (paper III).
- To assess the reliability of self-reported form of FGM in Sudan and to compare these reports to the extent of cutting verified by clinical examination (paper IV).
- To test the hypothesis that the structural changes caused by FGM, affecting the flow of urine and increasing the risk of urinary tract infections could, in the long term increase the risk of CKD in Sudanese girls (paper V).

4 ETHICS

Concepts of ethics have been derived from religions, philosophies and cultures. At its simplest ethics can be defined as system of moral principles or norms for conduct that distinguish between acceptable and unacceptable behavior. They affect how people make decisions and lead their lives; it is concerned with what is good for individuals and society.

Many prominent medical researchers in the 19th and 20th centuries conducted experiments on patients without their consent and with little if any concern for the patients' well-being. U.S. Public Health Service Syphilis Study at Tuskegee 1932 – 1972 is a stark example. The study was performed to investigate the natural history of untreated Syphilis, nearly 400 black men with syphilis from Macon County, Ala., were enrolled in the study. They were never told they had syphilis, nor were they ever treated for it.

Physicians in Nazi Germany performed research on subjects that clearly violated fundamental human rights. Following World War Two, some of these physicians were tried and convicted by a special tribunal at Nuremberg, Germany. The basis of the judgment is known as the Nuremberg Code, which has served as one of the foundational documents of modern research ethics.

The World Medical Association was established in 1947, the same year that the Nuremberg Code was set forth. In 1954, the WMA adopted a set of Principles for Those in Research and Experimentation. This document was revised over the next ten years and eventually was adopted as the Declaration of Helsinki (DoH) in 1964, which was revised several times since, providing guidance to the medical research community and has it has provided the guiding principles of our considerations in these studies as well.

The research process begins with the choice of the research topic, followed by selection of the appropriate research design, development of the research protocol, writing and submitting a research proposal for funding, implementing the study, description and analysis of the research results, interpretation of the research results, and finally communicating the research, including its publication. Ethical considerations apply throughout the research process.

Paragraph 15 of DoH:

“...every proposal for medical research on human subjects must be reviewed and approved by an independent ethics committee before it can proceed.” The reason for this is that neither researchers nor research subjects are always knowledgeable and objective enough to determine whether a project is scientifically and ethically appropriate.

Paragraph 12 of DoH:

“... Medical research involving human subjects must be justifiable on scientific grounds”. It is not acceptable that the welfare and the respect of the individuals be compromised in the pursuit of benefits that may accrue to science and society.

Informed consent is vital for research ethics, participants in research must receive and understand the necessary information about the research study; and after considering the information, arrive to a decision without coercion, undue influence, inducement, or intimidation

The principles of the Declaration of Helsinki are equally applied to children, who are not legally able to provide consent. They can still have decision-making power through the provision of assent. Assent is not necessarily verbal. Sometimes children show in other ways they do not want to take part. In our studies the doctors, after taking the guardian consents, explained to the girls that the examination will also include inspecting the genitals. In cases where the girls refused, or even was shy the doctors did not force the girls and didn't proceed with the inspection.

Ethical committees in Sudan (University of Khartoum) and Sweden (Karolinska Institutet), respectively, have approved this study.

All respondents have given their informed consents before recruitment in any of the studies.

In our studies most of the respondents are poorly educated or illiterate. To ask them for written content, is ethically questionable. The women would not know what they were signing and might have concerns about whether the document could be used against them. We therefore decided to obtain oral consent (recorded and signed by the attending doctor) from respondents, having first told them in colloquial Arabic what was written on the standardized informed consent. Parental informed consent, and the assent of the girl, has been obtained before inclusion of girls to any of the studies.

Some women/ guardians refused participation. This indicates that we managed to assure them that participation was voluntary. Furthermore some girls refused

participation in spite of their guardians' permission. Thus we consider our method of taking guardian consent and girls assent was appropriate. In all the studies respondents who refused participation received the standard care appropriate for their condition.

Clinical examination in these studies included inspection of genitalia. While this would not have been routinely performed in emergency rooms, we argue that inspection of genitalia should be part of the routine examination in patients with urinary symptoms; otherwise important clinical findings might be missed.

For study I, there were no additional investigations than would normally be done. On the contrary, the research project supplied these women with investigations many of them could not have afforded themselves. Adhering to strict inclusion criteria for surgery (diagnostic laparoscopy), we were able to minimize the number of unnecessary surgical interventions. In all the studies we took precautions to safeguard the integrity of the girl or woman. All doctors collecting data received special training for this. For the studies on girls, specially trained female Sudanese medical doctors did all clinical examinations and data collection. Examination, including inspection of genitalia, took place in private in the presence of guardian/parents. In this way we took precautions to respect the privacy of the subject, and the confidentiality of the information.

We anticipate that our results will be useful in future work against FGM, as well as in improving health care for girls and women having undergone FGM. The morbidities addressed in this project can have severe future implications, and early diagnosis is essential in preventing progressive disease. The findings can be used at several levels, for instance as:

- Arguments against the practice in intervention programs in Sudan and elsewhere
- Arguments for screening of girls with FGM.

The results of these studies were presented to different levels of the health care system during dissemination seminars in Sudan and to advocacy groups in Sudan.

5 SETTING

5.1 SUDAN

Sudan, located in northeast Africa and measures about 1,861,484 sq. km (111), which is slightly less than one-fifth the size of the United States (figure 3).

Figure 3: Map of Sudan



Sudan is a multi-ethnic country with diverse cultures and traditions. Its neighbours are Chad and the Central African Republic and Libya on the west, Egypt on the north, Ethiopia and Eritrea on the east, and South Sudan on the south. The Red Sea washes about 800 kilometers of the eastern coast. Sudan is traversed from north to south by the Nile, all of whose great tributaries are partly or entirely within its borders. It is endowed with many natural resources including; petroleum; reserves of iron ore, copper, chromium ore, zinc, tungsten, mica, silver, gold and hydropower.

Military regimes have dominated national politics since independence from the UK in 1956 (112). Sudan was embroiled in two prolonged civil wars during most of the remainder of the 20th century. These conflicts were rooted in the centralized economic and political distribution of power. The first civil war ended in 1972 but broke out again in 1983. The final North/South Comprehensive Peace Agreement, signed in January 2005, granted southern Sudan autonomy for six years followed by a referendum on independence. South Sudan became independent on 9 July 2011. Since then, Sudan has been combating rebels from the Sudan People's Liberation Movement-North (SPLM-N) in Southern Kordofan and Blue Nile states. A separate conflict, which

broke out in the western region of Darfur in 2003, has displaced nearly two million people, many of whom have come to the capital. This means that people from all over Sudan can be found in or around the Khartoum area. The UN took command of the Darfur peacekeeping operation from the African Union in December 2007. Sudan also has faced large refugee influxes from neighboring countries, primarily Ethiopia and Chad. Armed conflict, poor transport infrastructure, and lack of government support have chronically obstructed the provision of humanitarian assistance to affected populations.

Sudan has a diverse ethnic composition with a total population of almost 35 million. Khartoum is the capital city (5 million -2009). The majority of Sudanese are Sunni Muslim with a small Christian minority. There is a variety of local languages in Sudan, but Arabic is the official and common language.

Sudan is an extremely poor country with a high maternal mortality rate (~ 730 deaths/100,000 live births (2010), as well as a high infant mortality rate (54 deaths/1,000 live births – 2013) (111). The oil sector had driven much of Sudan's GDP growth since it began exporting oil in 1999. For nearly a decade, the economy boomed on the back of increases in oil production, high oil prices, and significant inflows of foreign direct investment. Following South Sudan's secession, Sudan has struggled to maintain economic stability, because oil earnings now provide a far lower share of the country's need for hard currency and for budget revenues. Sudan is attempting to generate new sources of revenues, such as from gold mining, while carrying out an austerity program to reduce expenditures. Agricultural production continues to employ 80% of the work force. On-going conflicts in Southern Kordofan, Darfur, and the Blue Nile states, lack of basic infrastructure in large areas, and reliance by much of the population on subsistence agriculture ensure that much of the population will remain at or below the poverty line for years to come.

5.2 THE HOSPITALS

The infertility and STI studies were conducted in the department of obstetrics and gynaecology in Khartoum teaching hospital. Patients were recruited from two referral clinics, both public clinics connected to the department, the Fath Elrahman Elbashir referral clinic in central Khartoum and Soba University Hospital referral clinic. Soba is situated in the outskirts of Khartoum and thus receive patients from the rural area south of Khartoum as well as from Khartoum.

All the laparoscopies done for the study were done in Soba University Hospital in a well-equipped surgical theatre.

Study III was conducted in the children emergency hospital, which is a public hospital in central Khartoum. It is a well-staffed university hospital, and it serves as a tertiary hospital accepting referrals from all over the country. It is also the only hospital that provides services, care and treatment for free to children and thus people from all Khartoum and the surrounding areas come here.

The setting of the study on chronic kidney disease in relation to FGM was chosen in two nephrology units as these are the only two paediatric dialysis centres in Sudan. Cases were recruited from nephrology units in Soba University Hospital (The main paediatric nephrology unit in the country) and Dr Salma centre in the capital Khartoum (The nephrology outpatient clinic). Both centres belong to the University of Khartoum.

The paediatric nephrology service was started in Khartoum in 2001, as a sister renal center between Sudan and UK. Before then, older children were treated in renal centers supervised by adults' nephrologists.

Chronic haemodialysis became available in 2004, with a fully equipped eight bedded unit, followed by continuous ambulatory peritoneal dialysis (CAPD) in 2005. These are provided free at this unit, but renal transplantation remains only available within adults' units.

All these facilities are centered in the capital, Khartoum, and patients from different parts of the country have to travel to these centers for specialized nephrology care.

As girls who attend these centres are only patients with kidney disease our control group were recruited from the emergency department of the children emergency hospital, the same hospital setting as for study III.

6 PARTICIPANTS AND METHODS

This thesis is based on five hospital studies. An overview of the different design and methods used in the studies is shown in Table 2.

Table 2. Overview of the methods used in the five studies

	Study I	Study II	Study III	Study IV	Study V
Design	Cases control	Case control	Cross sectional	Cross sectional	Case control
Setting	Antenatal and gynaecology clinics, children emergency department	Antenatal and gynecology clinics	Children emergency department	Children emergency department, Antenatal and gynecology clinics	Paediatric Nephrology units, Children Emergency department
Study Population	Cases:99 Infertile women Controls:180 primigravidea	222 from women in study I	255 consecutive girls 4-9 years	Girls from study III and women from study I	Cases: girls 4-16 years with CKD/ESRF Controls: age matched girls 4-16years
Adjustments	Hormonal factors, male factor, age, socioeconomic, education and STIs	Age, education, infertility and socioeconomic level	Age, education, and socioeconomic level	Age, education, and socioeconomic level	Age, education, and socioeconomic level
Statistical analysis	Exact logistic regression	Univariate and multivariate logistic regression	Descriptive statistics	Descriptive statistics	Univariate and multivariate logistic regression

6.1 PAPER I AND PAPER II

6.1.1 Patients

We performed a hospital-based case-control study to investigate the possible relation between FGM and primary infertility (Paper I). Consecutive women with primary infertility and primigravidae were recruited from the outpatient clinics of Khartoum Teaching Hospital and Soba University Hospital, Khartoum between March, 2003, and June, 2004.

Cases were consecutive women fulfilling the inclusion criteria, and giving their informed consents.

Inclusion criteria were

1. Seeking medical care for primary infertility.
2. Aged 35 years or younger.
3. Had regular sexual intercourse during the past 2 years.
4. Had regular menstrual cycles for the past year;
5. Had never been pregnant.
6. Had never used an intrauterine device or hormonal contraceptives.
7. Had no history of abdominal surgery.
8. Normal semen analysis for husband with respect to count, morphology, and motility.

Cases who fulfilled these criteria underwent diagnostic laparoscopy at Soba Teaching Hospital.

Inclusion criteria for controls were:

1. Women expecting their first baby.
2. Achieving current pregnancy within 2 years of having regular sexual intercourse.

To assess if extensive forms of FGM are associated with high odds of acquiring STIs (Paper II), blood samples were taken by venepuncture from the women in Paper I; after giving their informed consent. Samples were then centrifuged; sera were kept frozen in -60 degrees to be sent to the microbiology department laboratory in Khartoum for *C. trachomatis* enzyme immunoassay (EIA) and Syphilis T.pallidum haemagglutination assay (TPHA). And to Statens Serum Institute, Copenhagen, where the gonococcal antibody test (GAT) for infection with *N. gonorrhoea* was performed.

6.1.2 Data collection

We obtained personal details—age, level of education, profession, tribe, religion, years of marriage, age at which the FGM operation was done if applicable, and any symptoms subjectively associated with this operation—by interview-administered questionnaire.

We did a genital examination for every woman, noting the extent of FGM. All women were recruited and examined in the same clinical settings by the same specially trained doctors. We made a particular effort to avoid observer bias with respect to the extent of vulval cutting, by giving detailed instructions to the gynaecologist as to how to visualize and how to describe the extent of anatomical excision observed.

We did various laboratory investigations: Haemoglobin, blood group analysis, and urinalysis for *Schistosoma haematobium* ova; and recorded the weight and height of participants.

We inspected the internal genital organs of women with primary infertility with diagnostic laparoscopy done at Soba University Hospital. We tested for tubal patency by pertubation with methylene blue through the cervix while inspecting the fallopian tubes.

We combined criteria to define socioeconomic status as:

- Low (household income $\leq 30\,000$ Sudanese Dinar, the Sudanese currency at the time of study, [about US\$115] per month, no house, poor level of education, unskilled labourer),
- Moderate (household income 30 000–150 000 Sudanese Dinars [\$115–575] per month, might rent house, skilled labourer, teacher, or salaried employee or clerk), or
- High (household income 150 000 Sudanese Dinars [\$575] per month, owns house with water and electricity, husband most often has university degree or is business man.

6.1.3 Statistical analysis

Paper I

In November, 2003, we noted that there was a different age distribution in cases and controls. Since age might be an independent factor affecting the risk of undergoing FGM or the severity of the operation, we decided to match cases and controls for age within 2 years.

We used exact conditional logistic regression, stratifying for age group (<22, 23–24, 25–26, 27–28, 29–30, 31–32, and ≥33 years), to reduce to a minimum the potential confounding effect of age in the comparison of cases and controls. An exact method guarantees that the result will not exceed its nominal significance level, and the confidence interval will always equal or exceed its nominal coverage level.

In the univariate stratified logistic model, we compared cases and controls by extent of FGM (form involving labia majora versus other forms of FGM or no FGM).

To control for possible confounders, we also fitted a multivariate model to the data. In addition to extent of FGM, we used three variables in the multivariate stratified model: years in school (treated as a continuous covariate), socioeconomic status (low versus medium and high), and seropositivity for at least one of *N gonorrhoeae* and *C trachomatis* versus negative for both. The two models were fitted with LogXact-5 for Windows. We based the univariate model on 278 observations and the multivariate model on 210 observations. We calculated exact odds ratios (ORs) with 95% confidence Interval (CI).

To compare cases with tubal pathology and cases with normal laparoscopy findings with respect to time interval between the FGM operation and time of observation, we used the Mann-Whitney *U*man.

Paper II

Chi-square test was used to analyze differences between proportions, with a value corresponding to $P < 0.05$ for significance unless otherwise stated.

In the multivariate analysis, cases and controls were compared by the extent of FGM (forms involving labia majora versus other forms or no FGM) using logistic regression controlling for age, education and duration of marriage (treated as continuous variables), whether infertile or not and socio-economic level (low versus medium and high).

Continuous variables were analyzed by a nonparametric test, Mann–Whitney.

6.2 PAPER III

6.2.1 Patients

The study was designed to be a descriptive study of FGM among girls seeking emergency care. Data was collected by four specially trained female doctors in the emergency ward at the Children’s Emergency Hospital, Khartoum, data collectors

worked in the emergency ward daytime on selected days during the period March to August 2004.

All guardians of girls aged 4–9 years presenting to the emergency ward were asked for their informed consent to take part in the study.

6.2.2 Data collection

Social and medical histories were taken. The guardians, and the girl when appropriate, were asked about the FGM operation. A full examination, including inspection of genitalia, was performed on those who accepted it. Type and extent of genital operation, for those with FGM, were registered, as well as information on other health conditions.

Socioeconomic level was defined according to the same criteria as for paper I&II, described above.

6.2.3 Statistical analysis

Differences between proportions were analyzed by Chi-square test, adjusted by Pearson's or Fisher's exact test, depending on the number of observations. Odds ratios were calculated with 95% confidence intervals.

For continuous variables such as age and years in school we used a non-parametric test (Mann-Whitney) for significance testing of differences.

6.3 PAPER IV

6.3.1 Patients

The 282 women from study (I) and the 255 girls from study (III) constitute the study population for this paper.

6.3.2 Data collection

For both groups, those who reported having undergone genital mutilation were then asked at what age and what form of FGM had been done. After obtaining informed consent from the woman or guardian, the doctor conducted a full physical examination, including genital inspection, to verify the exact anatomical extent of the operation.

For the girls, the examination was performed by female paediatricians in a secluded room to guarantee privacy. The women were examined by gynecologists in the gynaecological outpatient clinic.

All doctors had received special training so they classified FGM in the same way. Particular efforts were made to avoid observer bias concerning the extent of vulval damage. Doctors were given detailed instructions on how to visualize and describe the extent of anatomical excision seen in each patient (to describe whether the clitoris, labia minora, and labia majora, respectively, were untouched, partially removed, or totally removed and whether the sides were stitched and at what level), using the table below

Table 3. Table used for collecting data on extent of FGM

<u>Anatomy:</u>	Untouched	Partially removed	Totally removed	Sides stitched together
Clitoris				
Labia minora				
Labia majora				

Other findings (e.g. fenestrations of infibulation, inclusion cysts):

All the women and the guardians of girls included in the study gave their informed consent and the girls their informed assent.

Socioeconomic level was defined according to the same criteria as for paper I&II, described above.

6.3.3 Statistical analysis

We used the Mann-Whitney test to analyze continuous variables and chi₂ to test for differences between proportions, with $P < 0.05$ indicating significance unless otherwise stated.

6.4 PAPER V

To investigate the possible association between FGM and CKD/renal failure we conducted a hospital based case control study, during the period June 2006 and March 2008.

6.4.1 Patients

Cases and controls were consecutive patients attending the outpatient clinic or emergency department, respectively; their guardian having given informed consent to take part in the study, and fulfilling the inclusion criteria.

Cases were 50 girls, 4-16 years of age with known chronic kidney disease or end stage kidney disease

The control group were age-matched girls +/- 2 years, recruited from the paediatric emergency of the Children Emergency Hospital. The inclusion criteria were girls between 4 and 16 years of age with symptoms other than urogenital symptoms.

6.4.2 Data collection

CKD was defined as glomerular filtration rate (GFR) less than 50 ml/min per 1.73 m² body surface area, estimated by the Schwartz formula when an accurate height had been recorded. Alternatively, we used serum creatinine values above 221 µmol/l (2.5 mg/dl) for 3–10 year olds, and 265 µmol/l (3 mg/dl) for 10–15 year olds.

Cases were recruited from nephrology units in Soba University Hospital (The main paediatric nephrology unit in the country) and Dr Salma centre in the capital Khartoum (The nephrology outpatient clinic). Both centres belong to the University of Khartoum. All cases had an ultrasound done as part of routine investigation of kidney disease. Cases with known syndrome or congenital malformation were excluded from the study.

Data has been collected using interview administered structured questionnaires, which were similar to the questionnaire we used in study I.

A full examination, including inspection of genitals, was performed on both cases and controls. Female Sudanese doctors were trained in order to be able to clearly identify the different types of FGM. To achieve 80% power with assumption of 60% FGM prevalence among controls and 80% among cases, we aimed for fifty cases and three controls for each case. During the data collection period the data collector doctors had to move to other hospitals as part of their training program and to avoid observation error we decided to discontinue recruitment of controls at hundred and twenty eight.

To be able to control for possible confounders, socio-economic factors, education level of parents, housing etc. were recorded for both cases and controls.

6.4.3 Statistical analysis

Chi-square test was used to analyse differences between proportions, with a *p* value <0.05 for significance.

Age and number of years in school of cases and controls do not seem to be normally distributed. Thus we used a non-parametric test (Mann-Whitney) for significance testing of differences concerning these continuous variables. We also used this method to compare cases and controls in regards to time since FGM had been performed with a *p* value <0.05 for significance.

We matched cases and controls for age +/- 2 years, since age might be an independent factor affects the risk of having undergone FGM or the severity of the type performed. Logistic regression analysis was used to compare cases and controls in regards to having undergone FGM. We also compared cases and controls by extent of FGM. To control for possible confounders we also used a multivariate model, in addition to FGM, we used three variables: age, years in school (both treated as continuous variable) and socioeconomic status (low versus medium or high). We calculated Odds ratios with 95% confidence intervals.

7 RESULTS

7.1 PAPER I

Ninety nine women with primary infertility underwent laparoscopy, of whom 48 had adnexal pathology suggestive of previous inflammation. One laparoscopy was inconclusive (large fibroid made inspection impossible) and the rest did not show any pathological features. 30 of the 48 abnormal laparoscopies showed bilateral tubal blockage, the rest showed unilateral block or adhesions. We recruited 180 controls, 91 before matching and 89 after.

7.1.1 Social characteristic of respondents

All participants were married. Table 4 shows the age distribution, socioeconomic status, and level of education (years in school) of the women.

The median age for the FGM operation was 7 years (range for cases 3–15, for controls 2–13) in both groups. There were only six Christians: three cases—one bilateral tubal block (no FGM), one inconclusive laparoscopy (no FGM), and one normal laparoscopy (FGM involving labia majora)—and three controls (two without FGM and one with FGM, involving labia majora). The remaining cases and controls were Muslims.

Table 4: Social characteristics of cases and referents

	Age			Socio-economy ^a			Years in school		
	Mean	Median	Range	Low	Medium	High	Mean	Median	Range
All cases (n=99) ^b	27,2	28	18-38	60 (61%)	35 (35%)	1 (1%)	9,9	12	0-18
Cases with tubal pathology (n=48)	28,3	29	21-38	31 (65%)	15 (31%)	1 (2%)	9,7	12	0-18
Referents before matching (n=91)	24	24	17-38	53 (58%)	34 (37%)	4 (8%)	11	12	0-18
Referents after matching (n=89)	25,5	25	18-38	41 (46%)	45 (50%)	1 (1%)	11,6	12	0-19

^a Information on socioeconomic missing on some respondents which means that percentage do not sum up to 100. ^b One case with inconclusive laparoscopy.

7.1.2 Forms of FGM and reported complication

The clitoris was damaged in all cases and controls with any form of FGM. In all forms that involved the labia minora the clitoris was also cut, and in all forms that involved the labia majora, the labia minora and the clitoris were partly or totally removed.

No woman had any sign of being deinfibulated (the bridging scar of type III having been cut).

Table 5 shows the anatomical extent of the FGM operations, whereas in table 6 the operations are classified according to the WHO criteria. The major difference between these classifications is that all types of suturing of the two sides, whether of labia minora or majora, are classified as type III, according to WHO. Table 5 therefore shows the effect of the anatomical extent of FGM and table 6 the effect of suturing.

Table 5. Anatomical extent of FGM among respondents.

The columns describe the maximal extent of the operation. For example, a patient classified “labia minora”, has undergone FGM involving clitoris and labia minora, but not extending to labia majora.

		no FGM		Clitoris		labia minora		labia majora		Total
		N	%	N	%	N	%	N	%	
Infertile cases	Tubal/adnexal pathology	1	2,1	1	2,1	-	0	46	95,8	48
	Normal laparoscopy	1*	2,0	4	7,8	-	0	46	90,2	51
Referents		5	2,8	14	7,8	29	16,2	131	73,2	179**
Total		7	2,5	19	6,8	29	10,4	223	80,2	278

* One case with inconclusive laparoscopy.

* Anatomical classification for one referent missing.

Table 6. Types of FGM classified according to the WHO classification

All forms involving stitching/suturing the two sides together, are classified as type III, independent if labia minora or majora are stitched.

	No FGM		WHO I		WHO II		WHO III		Total
	N	%	N	%	N	%	N	%	
Infertile case	2	2	5	5,1	1 ¹	1	91	91,9	99
Referent	5	2,8	14	7,8	8	4,5	152	84,9	179
Total	7	2,5	19	6,8	9	3,2	243	87,4	278

¹ A case where labia minora as well as majora were cut, but there was no stitching together.

Cases with tubal pathology had a longer interval between the FGM operation and our observation (median 21.5 years, range 12–32)—i.e., longer exposure to the possible effects of FGM—than cases with normal laparoscopic findings (19 years, 7–25; $p=0.015$).

Immediate complications were reported by few, and there was no difference between cases and controls. Three cases and seven controls reported having had fever after the operation and two cases and six controls admitted that they had to seek medical care because of immediate complications.

Repeated subjective symptoms of urinary tract infection (more than three episodes) were significantly more common in cases (41% [41 of 99], $p=0.012$), and in the subgroup of cases with normal laparoscopy findings (46% [23 of 50]; $p=0.011$), than in controls (26% [47 of 180]). The difference between the subgroup with tubal factor infertility (38% [18 of 48]) and controls was not significant ($p=0.16$). None of the specific forms of FGM is related to repeated urinary tract infection.

7.1.3 Factors related to infertility

Only two women had a body-mass index of less than 19 (both had tubal factor infertility) and nine cases had a body-mass index of more than 30 (five of whom had tubal damage).

None of the cases or controls had ova of *S haematobium* in their urine.

Women with primary infertility had a significantly higher risk of having undergone the most extensive form of FGM, involving labia majora, than controls, in both the univariate and the multivariate model (table 7). The two subgroups of cases (adnexal pathology and normal laparoscopy) both show significant associations in the univariate model and borderline significant associations in the multivariate model (table 7).

Because of the missing data (mainly serological) 68 observations are missing from the multivariate analysis, which leads to loss of analytical power, which in turn affects the results, especially in the subgroups. Suturing the two cut sides together—irrespective of whether the labia majora or minora were sutured (WHO III)—was not significantly associated with primary infertility, despite the higher prevalence among I fertile women (table 7).

There were too few cases (n=2) and controls (n=5) without FGM to allow any analysis of them versus those with FGM.

Table 7. The association between extent of FGM and primary infertility.

Exact conditional logistic regression (univariate and multivariate) with age group as stratification variable, used in all analyses.

		Univariate model (extent of FGM)		Multivariate model adjusting for extent of FGM, socio-economic level, years in school, <i>N. gonorrhoeae</i> and <i>Chlamydia trachomatis</i> .		
Anatomical classification of FGM (form involving labia majora vs. milder forms or no FGM)		Variable	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
All cases vs. all referents. Univariate: (n = 99 vs. 179) Multivariate: (n = 75 vs. 135)	FGM	3.62	1.46, 10.3	4.69	1.49, 19.7	
	Socio-economical. level			1.69	0.82, 3.54	
	Years in school			0.96	0.88, 1.05	
	Seropositivity			2.33	0.69, 8.25	
Cases with adnexal pathology Vs. all referents. Univariate: (n = 48 vs. 179) Multivariate: (n = 35 vs. 135)	FGM	5.74	1.28, 53.5	6.88	0.98, 301	
	Socio-economical. level			1.99	0.74, 5.70	
	Years in school			0.98	0.87, 1.10	
	Seropositivity			2.94	0.60, 15.2	
Cases with normal laparoscopy findings vs. all referents. Univariate: (n = 50 vs. 179) Multivariate: (n = 40 vs. 135)	FGM	3.38	1.10, 13.9	3.66	0.98, 20.7	
	Socio-economical. level			1.58	0.67, 3.84	
	Years in school			0.93	0.84, 1.04	
	Seropositivity			2.06	0.41, 9.66	
WHO classification of FGM (type III vs. milder forms or no FGM)						
All cases vs. all referents. Univariate: (n = 99 vs. 179) Multivariate: (n = 75 vs. 135)	FGM	1.71	0.66, 4.86	1.77	0.52, 7.10	
	Socio-economical. level			1.84	0.90, 3.83	
	Years in school			0.96	0.88, 1.05	
	Seropositivity			2.43	0.72, 8.51	
Cases with adnexal pathology Vs. all referents. Univariate: (n = 48 vs. 179) Multivariate: (n = 35 vs. 135)	FGM	2.23	0.54, 13.6	1.73	0.31, 18.5	
	Socio-economical. level			2.36	0.88, 6.73	
	Years in school			0.98	0.87, 1.10	
	Seropositivity			3.55	0.73, 18.2	
Cases with normal laparoscopy findings vs. all referents. Univariate: (n = 50 vs. 179) Multivariate: (n = 40 vs. 135)	FGM	1.67	0.52, 7.04	1.64	0.39, 10.3	
	Socio-economical. level			1.65	0.70, 4.00	
	Years in school			0.93	0.84, 1.04	
	Seropositivity			2.02	0.39, 9.58	

7.2 PAPER II

7.2.1 Study population

A total of 281 women were recruited. Due to logistical problems, it was only possible to obtain blood samples from 222 women. The social characteristics of respondents are described in Table 8. Data from women without sera do not differ significantly from the others regarding clinical or socio-economic aspects.

Table 8: Social characteristics of respondents

	Cases (seropositive for one or more STIs)	Controls (seronegative for all three STIs)	Respondents without Sera
Age Median (range)	26 (20–34)	25 (17–38)	25 (17- 36)
Socio-economic level			
Low	14 (54%)	106 (55%)	34 (58%)
Medium	12 (46%)	80 (42%)	24 (42%)
High	–	6 (3%)	-
Years in school Median (range)	10 (0–18)	12 (0–19)	12 (0- 18)
Duration of marriage (in months) Median (range)	36 (5–120)	13 (3–168)	12 (4- 180)
Religion			
Muslim	26	194	55
Christian	–	2	4

7.2.2 Seroprevalence in relation to the practice

The prevalence of *C. trachomatis*, *N. gonorrhoeae* and *T. pallidum* among the different forms of FGM is shown in Table 9. The seroprevalence was relatively low for all three infections, and only 12% had evidence of any of these infections.

Table 9. The prevalence of STIs among the different forms of FGM

The anatomical extent of FGM	<i>Chlamydia trachomatis</i>		<i>Neisseria gonorrhoeae</i>		<i>Treponema pallidum</i>		Seropositivity for any STI	
	N	%	N	%	N	%	N	%
No FGM	0	-	0	-	0	-	0	-
Clitoris	3	20	0	-	1	6.7	4	27
Labia minora	0	-	0	-	0	-	0	-
Labia majora	13	80	5	2.9	8	4.6	22*	13
Total (all respondents)	16	7.2	5	2.3	9	4.1	26	12

* one case had labia majora partially removed but not stitched

Table 10, outline the anatomical extent of FGM among cases and controls. Of cases positive for any STI, 85% had FGM extending to labia majora compared with 78% of negative controls, which is not a significant difference ($P = 0.58$ when controlling for the covariates whether infertile or not, age, years in school, socio-economic level and duration of marriage, Table 11).

Table 10. The anatomical extent of FGM among cases and controls

	No FGM		Clitoris		Labia minora		Labia majora		Total
	N	%	N	%	N	%	N	%	
Cases (seropositive for any STI)	0	-	4	15	0	-	22	85	26
Controls (seronegative for all three STIs)	3	1.5	11	5.6	29	15	153*	78	196
Total	3		15		29		175		222

* five controls had labia majora partially removed but not stitched

Table 11: The association between sexually transmitted infections and the extent of FGM.

	Univariate		Multivariate*	
Cases (seropositive for any STI) vs. Controls (seronegative for all three STIs)				
	OR (95% CI)	<i>P</i>	OR (95% CI)	<i>P</i>
Extent of FGM (labia majora vs. other forms or no FGM)	1.55 (0.49–6.49)	0.611	1.13 (0.73– 1.77)	0.58
Age			0.88 (0.50–1.56)	0.66
Infertility			0.88 (0.25–3.04)	0.83
Education			0.89 (0.79–0.99)	0.03
Socioeconomic level			1.27 (0.52–3.08)	0.60
Duration of marriage			1.01 (0.99–1.03)	0.24

* Adjusting for age, infertility, education, socio-economic level and duration of marriage

7.2.3 Seroprevalence in relation to social characteristics of respondents

There were no differences between those who were seropositive for STIs and those who were not regarding age or socio-economic level. Duration of marriage seemed to play a role ($P = 0.02$), but this significance disappeared after controlling for covariates. Those with seropositivity had shorter education ($P = 0.03$).

Classifying FGM according to the WHO classification instead of the anatomical extent does not change the results.

7.3 PAPER III

7.3.1 Patients and presenting complaints

Of 255 girls included in the study, the guardians of 249 agreed to full examination, including inspection of the genitalia. The median age (range) of the participants was 6 years (4–9). The most common presenting complaints were fever 61%, cough 47%, diarrhoea and vomiting 21%, abdominal pain 20% and burning micturition 4%. No case had symptoms related to FGM and no one with FGM presented with a genital complaint.

The 16 Christians recruited were from tribes that traditionally do not practice FGM. Although none of these girls had undergone FGM, for two there was an intention to have it done. They could not, however, specify what form of FGM. The calculations and comparisons below that relate the practice of FGM to social aspects include only the 239 Muslim respondents.

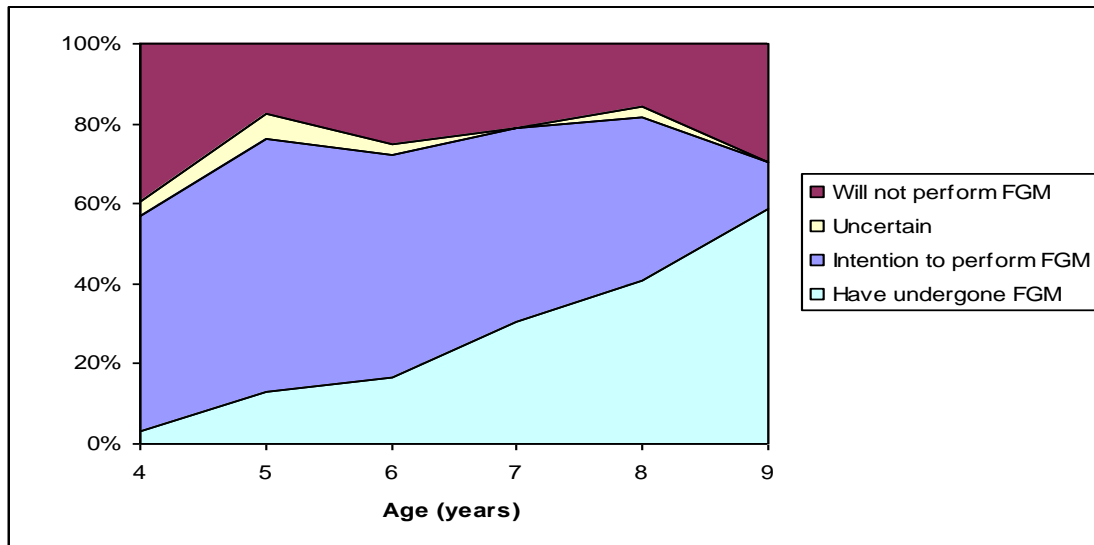
7.3.2 The practice

Of 255 girls, 52 had had FGM (20.4%), there was an intention to perform it on 128 girls (50.2%) and 75 (29.4%) had not been and would not be circumcised. Which means a predicted prevalence in the future as 70.6%, among the whole sample including Christians and 75% of the Muslim population in the sample.

The most prevalent type of FGM was type III, the most extensive form.

The prevalence of FGM and intention to perform it in different age groups is outlined in Fig.4.

Figure 4. FGM prevalence in different age groups.



The distribution of different types of FGM is shown in Table 12. In WHO type III, there was considerable variation in the extent of the operation. Of the 32 who had been infibulated, five (16%) had had the severe traditional type, leaving a very small vaginal opening (<5 mm), and in 12 (38%) the labia majora were not involved but the labia minora had been cut and sutured.

Table 12: The distribution of different forms of FGM according to the WHO classification.

WHO classification	N	% of those with FGM
Type I	13	27%
Type II	3	6%
Type III	32	67%
Type IV	–	–
Grand total	48	100%

Note: Classification made on basis of the anatomical changes described by the doctors who did genital inspection (four girls who were reported to have FGM but refused genital inspection are excluded)

The median age (range) for FGM was 5 (1–9) years. When all girls for whom FGM was intended were included, the overall median age (range) was 7 (1–12) years.

Most operations had been performed by trained midwives (33, 63%), followed by traditional birth attendants (TBAs) (17, 33%). One clitoridectomy had been performed by a doctor (2%) and in one case the guardian (2%) did not know who had performed it. TBAs were more likely to stitch the sides together, 88% having undertaken WHO type III, compared with 58% of midwives ($p=0.085$). In almost all those left with very tight vaginal openings, the operations had been done by TBAs.

7.3.3 The Determinants

Those who had allowed or would allow their daughters to undergo FGM were of significantly lower socio-economic status and had spent significantly fewer years in school, both mothers and fathers, than those who had not/would not (Table 13). No association was found between parental age and the practice of FGM.

Table 13: Social characteristics of Muslim respondents, leaving out those uncertain whether the girl should undergo FGM or not (n=7).

	Socio-economic level N (%)			Mother's age	Mother's years in school	Father's age	Father's years in school
	Low	Medium	High	Median (Range)	Median (Range)	Median (Range)	Median (Range)
Have or will have FGM (n=171)	152* (89%)	18 (11%)	–	29 (18-45)	3** (0-13)	39 (25-70)	5*** (0-17)
Will not have FGM (n=61)	42* (70%)	17 (28%)	1 (2%)	30 (19-45)	6** (0-16)	40.5 (27-60)	7*** (0-17)

Note: Missing data for two girls makes the sum not add up to total for socio-economic level.

* p=0.0008, OR 3.62 (1.6–8.1) ** p=0.0015 *** p= 0.0266

Regarding variations between tribes, the highest proportion of FGM was in tribes originating from the Gezira and central Sudan, the lowest in tribes from southern Sudan (Table 14).

Table 14: The prevalence of FGM among different tribes, categorized according to their origin.

Tribe category	Have/will have FGM		Have not/will not have FGM		Total
	(n)	%	(n)	%	
North Sudan Nubians	5	62.5	3	37.5	8
North Sudan Arabs	27	69.2	12	30.8	39
Gezira and central Sudan	46	86.8	7	13.2	53
West Sudan Arabs	33	67.3	16	32.7	49
West Sudan Africans	58	73.4	21	26.6	79
Southern Sudan	2	12.5	14	87.5	16
Non- Sudanese	4**	66.7	2***	33.3	6
Total	175		75		250*

* Data missing regarding the tribe for five cases. ** Three from Chad and one from Egypt.

*** One from Chad and one from Palestine.

Paradoxically, of the girls who were over 7, those who had undergone FGM were more likely to attend school regularly. Only one of 28 girls with FGM in this age group, but 10 of 37 without FGM, did not attend school (p=0.02). The result was the same when

Christian girls were excluded. Turning the figures the other way around, among girls over 7 attending school, half had had FGM, but among those not attending school only one of 10 had had FGM. School attendance by girls over 7 years of age was not significantly affected by socio-economic level (low 82%, moderate 86%) or tribe. The prevalence of FGM in girls over 7 years of age was approximately 50% for both low and moderate socioeconomic levels. Thus, FGM status was the only factor significantly associated with school attendance.

7.4 PAPER IV

7.4.1 Study population

Altogether we included 537 participants in the study: 255 girls, aged 4-9 and 282 women aged 17-35. Of these, 52 girls and 275 women had undergone FGM. We had no data on the anatomical extent of FGM (clinical inspection of genitals) for two women and four girls. For one girl and one woman information was missing on reported form. Ten women did not know their form of FGM. Genital inspection verified FGM in all women and girls reported to have undergone the procedure. Correspondingly, none of those who said they did not have any form of FGM were found to have it.

7.4.2 Anatomical features of different forms of FGM

The anatomical features of the different traditional terms used to describe forms of FGM and the WHO classification are shown in Tables 15 and 16, respectively. Many who said they had undergone “Sunna” (which should correspond to WHO type I) had a form of FGM extending beyond the clitoris (20/35 (57%) women and 10/23 (43%) girls). Nineteen (54%) women and nine (39%) girls reported to have undergone “Sunna” actually had WHO type III (infibulation and excision of part or all of external genitalia). Out of those who reported that they had undergone the “intermediate” form, 14 (82%) women and four (80%) girls had WHO type III, as classified by the doctor on inspection.

The anatomical extent of forms classified as WHO type III varied widely (table 16). In 27 (11%) women and 12 (38%) girls classified as having WHO type III, the labia minora were stitched but the labia majora were not involved. Thus there is a substantial overlap, in an anatomical sense, between WHO types II and III.

Table 15: Correlation between anatomical extent of FGM and reported form in 47 girls and 262 women* who had reported a form of circumcision and had genital inspection done.

Anatomical extent of genital mutilation	Reported form of genital mutilation					
	“Sunna”		“Intermediate”		“Pharaonic”	
	Girls	Women	Girls	Women	Girls	Women
Prepuce only	0†	0†	0‡	0‡	0‡	0‡
Part or whole clitoris	13†	15†	0‡	2‡	0‡	1‡
Clitoris + labia minora without stitching	1§	1§	1†	0†	1‡	1‡
Clitoris + labia minora with stitching	5§	7§	0†	3†	7‡	16‡
Clitoris + labia majora without stitching	0§	0§	0§	0§	1‡	6‡
Clitoris + labia majora with stitching	4§	12§	4§	11§	10†	187†

Sunna should correspond to WHO type I; pharaonic should correspond to WHO type III.

*Information missing on reported form for one girl and one woman; 10 women did not know their form of FGM; data missing on anatomical extent of FGM (clinical inspection of genitals) for two women and four girls.

†Expected extent of operation.

‡Over-reporting of extent of FGM.

§Under-reporting of extent of FGM.

Table 16: The actual anatomical extent of the different forms of FGM, as classified by the WHO.

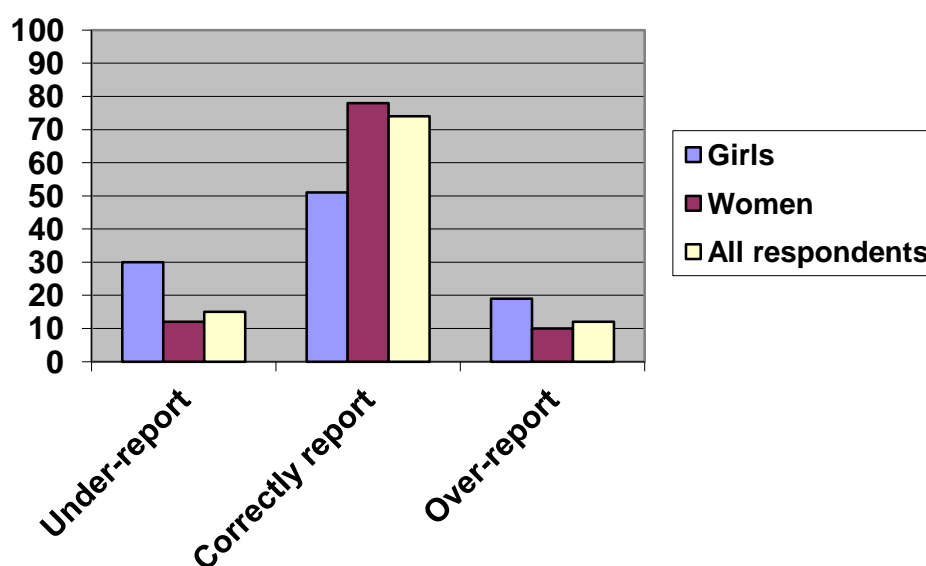
Anatomical extent of genital mutilation	I		II		III	
	Girls	Women	Girls	Women	Girls	Women
Prepuce only	–	–	–	–	–	–
Part or whole of clitoris	13	19	–	–	–	–
Clitoris + labia minora without stitching	–	–	3	2	–	–
Clitoris + labia minora with stitching	–	–	–	–	12	27
Clitoris + labia majora without stitching	–	–	–	7	1*	5*
Clitoris + labia majora with stitching	–	–	–	–	19	213

* The girl and the five women had labia minora stitched; the labia majora were cut, but not stitched

This study shows that the form of FGM is reported incorrectly in one in four respondents. Figure 5 shows the proportions of girls and women who under-reported, correctly reported, and over-reported their form of FGM.

Out of the 10 women who did not know their form of FGM, seven had type III.

Figure 5. The proportion of girls and women who under- report, correctly report and over-report their form of FGM (%).



We carried out further analysis to check for the possible influence of other factors on the results. When those women who reported their form correctly were compared with those who did not, the two groups did not differ regarding age (median 25 for both, $P = 0.8$), years in school (median 12 for both, $P = 0.18$), or years since the procedure was performed (median 19 and 18, respectively, $P = 0.87$).

Comparison of guardians who reported the correct form of FGM in their girls with those who did not also showed that the two groups did not differ regarding age (median 29 and 30.5, respectively, $P = 0.45$) and years in school (median 1 and 2, respectively, $P = 0.99$), but for those who reported the form correctly the time elapsed between the procedure and the observation was shorter (median 1 and 3 years, respectively, $P = 0.002$).

Table 17 shows how the distribution of forms of FGM varied in the study population, depending on what classification is used.

Table 17. The distribution of forms of FGM according to different classification systems.

	WHO classification (n=321)*			Reported form of FGM (n=315)**			Anatomical extent of genital mutilation (n=321)*		
	Type I	Type II	Type III	Sunna	inter-mediate	Pharaonic	Clitoris	Labia Minora	Labia Majora
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Girls aged 4-9	13 (27)	3 (6)	32 (67)	27 (53)	5 (10)	19 (37)	13 (27)	15 (31)	20 (42)
Women aged 17-35	19 (7)	9 (3)	245 (90)	35 (13)	17 (6.4)	212 (80)	19 (7)	29 (11)	225 (82)
Total	3 (10)	12 (4)	277 (86)	62 (20)	22 (7)	231 (73)	32 (10)	44 (14)	245 (76)

Data in this table are based on 52 girls and 275 women (in total 327) who had undergone FGM. The total number of respondents are not the same in the different classifications due to some missing data.

* Data missing on two women and four girls who did not agree with genital inspection. ** Reported form missing for one girl and one woman and ten women did not know their form.

7.5 PAPER V

In total 50 cases with chronic/end stage renal failure and 129 controls were recruited. Out of the 179 respondents who all agreed to take part in the general part of the study, 42 cases and 116 controls accepted full participation including genital inspection. Data on FGM is missing on three controls and they reported no FGM was performed. Thus they are not included in the total number of cases and controls on analysis.

7.5.1 Social characteristics of respondents

Table 18 shows the age distribution, socioeconomic status and level of education (years in school) of the girls. The median age for cases was 13 years (range 3-16) and for controls was 11 years (range 4-16), there was no significant difference between the two groups ($p = 0.5$). There were no significant differences in socioeconomic ($p = 0.93$) and education levels between the cases and the controls ($p = 0.22$). There were only

nine Christians, four cases and five controls all without FGM. The rest of the respondents were Muslims.

Table 18: Social characteristics of participants

†Information missing for some respondents.

	Age in years (49 cases, 128 controls)			Socio-economy (47 cases, 125 controls)			Years in school (47 cases, 127 controls)		
	Mean (SD)	Median	Range	Low	Medium	High	Mean (SD)	Median	Range
cases	12.7 (2.9)	13	3-16	36 (76.6%)	11 (23.4%)	0	3.9 (3.8)	4	0-10
controls	10.8 (3.0)	11	4-16	95 (76%)	30 (23%)	0	3.5 (3.1)	3	0-11

7.5.2 Forms of FGM

Among all the respondents who agreed to take part in the study, eight cases and thirteen controls refused genital inspection and the data were missing on three controls so those 24 respondents were not included on the analysis of prevalence and types of FGM.

In total 61 respondents had undergone FGM with a large number (48) among the rest intending to perform it, making a future prevalence of 71%, as shown in Table 19.

Table 19: Prevalence of FGM among all respondents

	FGM N (%)	Intention to perform FGM N (%)	Total N (%)
Cases (42)	25 (59.5%)	2 (4.7%)	27 (64.3%)
Control (112)	36 (32.1%)	46 (41%)	82 (73.2%)
Total (154)	61 (39.6%)	48 (31%)	109 (70.7%)

Out of the girls with FGM, who accepted genital inspection to verify the extent of FGM, 15(24.6%) had type I, 5(8.2%) had type II and 41(67.2%) had type III.

Table 20 shows the anatomical extent of the FGM operations, whereas in table 21 the operations are classified according to the WHO criteria. The major difference between

these classifications is that all types of suturing of the two sides, whether of labia minora or majora, are classified as type III, according to WHO.

Table 20: Anatomical extent of FGM among cases and controls.

	No FGM N (%)	Clitoris N (%)	Labia minora N (%)	Labia majora N (%)	Total
Cases	17 (40.5%)	5 (20%)	12 (48%)	8 (32%)	42
Controls	76 (67.9%)	10 (27.8%)	12 (33.3%)	14 (38.9%)	112
Total	93 (60%)	15 (20%)	24 (32.8%)	22 (30.1%)	154

Table 21: Types of FGM according to the WHO classification among cases and controls

	No FGM N (%)	Type I N (%)	Type II N (%)	Type III N (%)	Total
Cases	17 (40.5%)	5 (20%)	3 (12%)	17 (68%)	42
Controls	76 (67.9%)	10 (27.8%)	2 (5.6%)	24 (66.7%)	112
Total	93 (60%)	15 (24.6%)	5 (8.2%)	41 (67.2%)	154

Thus, Table 20 shows the effect of anatomical extent and Table 21 shows the effect of suturing and opposition of the two sides, therefore, covering of the urethral meatus. In all forms that involved the labia minora the clitoris was also cut, and in all forms that involved the labia majora, the labia minora and the clitoris were partly or totally removed.

The median age for the FGM operation was 5 years and 6 years for cases and controls respectively, (Range for cases 3–12, for controls 2–11). Cases had a longer time since FGM was performed (median 7.9 years, range 2–12), than controls (median 5.9 years, range 0-11; $p=0.003$).

7.5.3 Factors related to kidney disease

There was a significant difference in reporting immediate complications between cases and controls ($p=0.001$). Immediate complications were reported by 22 cases (68.8%)

and 14 controls (13.5%). Two of the cases reported bleeding and four urine retention. Data on complications were missing on 24 controls.

All respondents and their guardians were asked about history of having had symptoms of UTI, recurrent or not, and whether or not received treatment for it. Reporting subjective symptoms of urinary tract infection was significantly more common in cases (95%, 47/49, $p = 0.02$), than controls (35%, 45/129). 40 % of the cases reported more than three episodes.

When we fitted the multivariate model, the three extra variables were not significant, however, we decided to include them in the final model.

Cases seem to have undergone FGM significantly more often than controls (OR 2.3, $p = 0.02$, CI 1.9-5.8), Table 22. We also compared cases and controls in regards to having undergone FGM type 3 versus having milder forms of FGM or no FGM and there was no significant difference (OR 1.3, $p = 0.4$, CI 0.61-3.2), Table 22.

Table 21: The association between FGM and kidney disease

* adjusting for age, education and socioeconomic level

	Univariate		Multivariate*	
FGM vs. No FGM				
Cases vs. controls	OR (95% CI)	<i>P</i>	OR (95% CI)	<i>P</i>
FGM	2.3 (1.9-5.8)	0.02	2.5 (1.8-9.6)	0.04
Age			0.79 (0.68-0.91)	0.07
Socioeconomic			0.46 (0.17-1.2)	0.11
Years in school			0.21 (0.08-0.55)	0.09
Extent of FGM (Type III vs. no FGM or type I&II)				
Cases vs. controls	OR (95% CI)	<i>P</i>	OR (95% CI)	<i>P</i>
FGM extent	1.3 (0.61-3.2)	0.4	1.64 (0.39–7.3)	0.71
Age			0.83(0.69-1.00)	0.06
Socioeconomic			1.5 (0.46-4.9)	0.49
Education			0.71 (0.58-1.86)	0.1

8 DISCUSSION

Previously, there has been little research on girls, who are the primary victims of FGM. In this thesis we focus on the girl child, as we tried to explore the severe sequelae the girl could experience as result of FGM, resulting in complications already as a child or later in life. By performing this series of hospital based studies we were able to compare self-reported forms of FGM with clinically verified anatomical descriptions, which provides an accurate up-to-date description of the practice of FGM in Sudan.

8.1 METHODOLOGICAL CONSIDERATIONS

8.1.1 Data collection (Internal validity)

In this thesis we made huge efforts to avoid systemic error that can affect internal validity. Data collection forms for study I-III were pilot tested and revised before data collection. Similar forms were used for study V with few modifications according to the research question.

Data collection was closely supervised and monitored by the researcher. All forms were checked, and incomplete forms were discussed with the data collector for clarification. Double data entry was conducted by the author and supervisor (SE and LA). Incorrect entries were checked and verified against the original forms.

8.1.2 Generalizability (External validity)

It might be argued that the samples are not representative of the Khartoum population since it was collected in hospitals. In order to examine genitalia and not rely solely on what patients say regarding the type of FGM, studies should be conducted in a clinical or hospital setting.

In our studies, most presenting complaints were not related to the genitals, and there were no apparent immediate complications owing to FGM, which indicates no selection bias with regard to FGM.

For the studies on girls, The Children's Emergency Hospital is the only hospital in Khartoum with a fully free service and people from all over the capital seek healthcare there. Most patients, therefore, are of low socio-economic status, as are the majority in Khartoum. The sample included patients from almost all parts and tribes of Sudan.

For study I and II Patients were recruited from two referral clinics, both are public clinics connected to the university department, the Fath Elrahman Elbashir referral

clinic in central Khartoum and Soba University Hospital referral clinic. Soba is situated in the outskirts of Khartoum and thus receive patients from the rural area south of Khartoum as well as from Khartoum. Soba Hospital also accepts private patients on fee paying services. Thus patients from different socioeconomic levels can be recruited here.

The prevalence of FGM among girls in our study (40%) corresponds with the figures for girls aged 4–10 years in Khartoum reported in the SHHS in 2006 (41%). Thus, the sample probably gives a true estimate of the present situation in Khartoum, despite being collected in hospitals.

We are aware that there is no ideal group of controls available to recruit from the same population as the cases. Bearing in mind the need for genital examination, the control groups recruited in these studies would, however, seem to be the least biased that is also practically and ethically justifiable. On the other hand there was no difference in level of education, or with respect to socioeconomic status, between cases and controls. Therefore, we consider the results to be generalizable, concerning the effect of FGM, even if the study populations are not representative of Sudanese girls and women as a whole.

In study I, matching might have introduced a selection bias, and controls recruited before matching perhaps should not have been grouped together with those recruited after.

The effect of matching was, however, deliberately so, higher age among controls, but apart from this fact, matching had no significant effects. Characteristics of cases and controls differ very little, especially considering the general situation for Sudanese girls and women. By stratifying for age when calculating the ORs in study I, the age differences between cases and controls were taken into account and compensated for.

8.1.3 Recall bias

Recall bias in the women and guardians might have affected the results. Many factors contribute to recall bias, not least psychological aspects, and it is not possible to control for most of them. Time elapsed between the procedure and the observation could be relevant. For adult women there was no difference in this time period between those who reported correctly and incorrectly, but for girls there was. It is difficult to explain this difference, but it probably has more to do with a tendency to justify what has been done by using the religious term “Sunna” than the time that had passed.

One could argue that curtesy bias might have affected the reporting, which could be true especially as in Sudan as FGM is still considered the norm and that reporting Sunna has a religious value. Thus women would have felt they would be expected to report Sunna. On the other hand all types of FGM were illegal when we conducted the study and one would expect women or guardians not to disclose whether they have undergone the operation or not.

The results of study II are not representative of women in Khartoum or in Sudan. Infertile women, as has been shown in previous studies in Africa, constitute a group that carries a higher risk of acquiring STIs (95,96). The other group of respondents were pregnant women, which is the healthiest group coming to hospital, where we can justify the need for genital examination and taking blood samples. It is the least bad alternative group that can be used as a proxy for the normal population.

In study V there was a higher rate of reporting immediate complication among the cases than among the controls. Also there were significantly higher rates of history of urinary tract infection among the cases than the controls. The immediate complications described in the literature, however, derive mainly from data reported by adult women, and our results are at least closer in time to the FGM operation. On the other hand, we cannot exclude recall bias influencing the results.

8.1.4 Observer bias

To avoid observation bias all the doctors who performed genital inspection received special training on how to classify and assess the extent of genital cutting. There was no blinding of the observer—that is, the doctors who examined the women and girls and classified the form of FGM knew what form the women or guardians had reported. To obtain an accurate classification, the doctors described in anatomical terms what had been removed and stitched and classified the type afterwards on the basis of the records.

In study V, we had to stop recruiting controls as the data collectors had to move jobs. To train further data collectors would have introduced a possible observer bias, which we decided not to do.

8.1.5 Other limitations

One important limitation in study V is that we do not know the aetiology of CKD in the cases. All cases had an ultrasound done as part of routine investigation of kidney disease, which showed in majority, because of late presentation, small contracted

kidneys. We excluded girls with known congenital causes of kidney disease. We should have looked for different causes of CKD among our cases. Unfortunately this was not possible. Most cases present late, and are at end stage renal failure already at diagnosis. Thus, it would most likely be too late to investigate and ethically not acceptable just for the purpose of the study. Also, for the diagnosis of UTI we rely on reports on subjective symptoms and treatment, which in principle is not adequate. On the other hand, this is as close as we could come in the present setting, and the questions were asked in the same way both for cases and controls.

8.2 THE PRACTICE

Female genital mutilation is widespread in Sudan. The prevalence of FGM among all respondents of study V was 40%, which corresponds to the prevalence for girls age 4 to 10 years in SHHS 2006 (57), with a large share of guardians intending to perform the procedure, giving a future prevalence of 71%. This is comparable to the 70% prevalence in the study setting in the last SHHS in 2006 (57), and to our previous research in a similar setting (72%) (106). These results are also consistent with results from a recent review article that showed the overall prevalence of FGM has only declined very little (113). It is not known, however, to what extent those who are intending not to perform FGM will fulfil their intention in the future.

The literature suggests reporting of attitudes towards less severe forms. In Sudan, several studies have reported a change of practice from infibulation to type I, at least among young, educated people (6,10,33). This change from infibulation to Type I was obvious also in the DHS report (56); out of those who have undergone FGM, almost 84% had Type III. In paper I we found the prevalence of type III among the women to be 90%. This is consistent with the DHS report. In our studies on young girls in paper III and paper V, Type III remains the most common type (67%), but with more tendency towards less severe forms. This is consistent with recent surveys in Sudan. Over 60% of women have been subjected to type III FGM and 22% to Types I and II in Northern Sudan according to the safe motherhood survey in 1999 and the first Sudan National Household Survey in 2006 (57). Still, we have to bear in mind that it is difficult to compare our results based on clinical observations with previous studies based on interviews, since we know the reliability of reported form may be low (Paper IV).

8.2.1 The determinants

Paper III, indicates some socio-economic and educational determinants of the practice of FGM. Education level is a very important determinant. It is generally agreed that women's education may contribute to a reduction of the practice (19). Our findings support this and indicate that the risk of the daughter to undergo FGM decreases with the increase of education level of a mother. Several other studies have reported a negative association between FGM and the education level of mothers (10,33,41). Furthermore this study shows that the same negative association exist also for the father, which agrees with previous studies from Sudan (32,33) . Men seem to play a more important role than previously known, which may reflect the decision making process on FGM and the potential power of the father in making such decision.

The practice is deep-rooted and there is considerable social pressure influencing girls and parents to have FGM done. Social pressure from peers and from outside the family might exert a strong influence. This can be seen, for instance, in the fact that some Christians intended to allow their daughters undergo FGM, despite coming from tribes that do not traditionally practice it. Social pressure is also apparent in the finding that girls attending school were more likely to have undergone FGM than those who did not. To avoid name calling and associated bullying, girls sometimes ask for the operation to be done even when their parents have decided against it (114). In Sierra Leone some of the girls in a recent study have reported deciding themselves to have FGM done (115). Another factor might be to protect the girls when they leave home to go to school, a protection based on the traditional belief that FGM protects girls from immorality and sexual assault (116,117).

Recently there has been a strong debate in Sudan concerning the religious aspect of FGM. Article 13 of the law which prohibits all forms of FGM was removed by the Council of Ministers from the Child Act Bill in 2009. This decision followed a fatwa of the Islamic Jurisprudence Council, which called for a distinction to be made between the various forms of FGM and not to ban Type I which is known in Sudan as the "*Sunna*" type. This is in spite of the fact that a number of Islamic scholars elsewhere have issued various Islamic Fatwa on the issue of FGM most of which have disassociated FGM from Islam quoting both *Quran* as well as *Hadith*. Dr. Muhammad Lutfi al-Sabbagh, Professor of Islamic studies at King Saud University in Saudi Arabia states:

"Since all these risks are involved in female circumcision, it cannot be legitimate under Islamic law, particularly since nothing that recommends it is definitely established as said by the Prophet {Peace Be Upon Him}. It is, however, established that he has said: 'Do not harm yourself or others'. This hadith is one of the basic principles of this True Religion. Female Genital Mutilation is therefore neither a religious requirement or obligation, nor a Sunna" (38).

This debate, however, has reawakened many positive forces like medical community, activists and campaigners against FGM. But still some female gynaecologist promote the practice.

It is important to note that none of the girls or the women in our whole study sample had only the prepuce excised, the form that these Islamic leaders believe is "Sunna".

Our findings from these studies are thus very important in this heated debate.

8.2.2 The reliability of reported form

The reliability of reported form of FGM is low (Paper IV). It is important to be aware of this aspect in the design and interpretation of epidemiological and clinical studies on this topic.

In this study there was complete agreement between reporting having undergone FGM or not and what was found by inspection of genitals, in both girls and women. Similar result was found in Sierra Leone, where girls and women correctly report whether they have undergone FGM, but cannot accurately describe the cutting extent (115). Our findings differ, however, from previous studies in urban and rural Tanzania where there was inconsistency between self-reported and clinically determined FGM in more than 20% of women (women tended to say they had not undergone FGM when they had) (40,41). This disagreement between self-reporting and examination finding was seen in a study in Iraqi Kurdistan region, in which 11 % of respondents reported that they had been mutilated, while clinical examination revealed no mutilation (118). These studies investigated the reporting of having undergone FGM or not and did not comment on the reliability of reporting of different forms. A study from Nigeria showed that self-reporting was reliable in 79% of women (42). In this study most women were unsure of what had actually been done, so the authors could not investigate the reliability of reporting by type. In rural Gambia a community based study showed 97% agreement between reported status of FGM and what was found on examination (39). Among those who reported incorrectly, in more than half of those who reported having

undergone the procedure examination found no evidence of FGM, and in a quarter there was under-reporting of the extent of FGM.

Results from Paper IV shows that the self-reporting of different forms of FGM is not reliable. This should be considered in the interpretation of studies based on interviews showing a change in practice towards less severe forms (17,33). There could be other reasons for reporting milder forms, rather than a change in practice per se.

“Sunna” means: in accordance with the specific words, habits, practices, and silent approvals of Prophet Mohammed. One possible explanation for the extensive over-reporting of the “Sunna” form observed in this study, could be to justify the practice by referring it to a religious term. It could also be that the practitioner who performed the operation called it “Sunna,” even though she did a more extensive form.

Our findings from these studies have attracted national and international attention. In Paper I we have explored a very important social consequence of FGM from a medical perspective, primary infertility. Since it was published, it has been used a lot in campaigns in Sudan and other countries. Also it has been referred to by more than thirty published articles internationally.

Similarly, paper IV has attracted attention and has been referred to by more than twenty published articles. Based on the findings of this study, among others, the WHO has revised the classification and typology of FGM and came up with subdivisions to the forms in 2008 (9). Locally in Sudan this evidence has informed the type of question in the SHHS on prevalence where the question was based on “any type of FGM” rather than on specific type. Moreover, this may have also influenced the overall national campaign where the National Strategy on Abolition of FGM of 2008 was focusing on all types rather than one specific type of FGM.

The findings in Paper IV have shown the importance of being more attentive to the meaning of the traditional terms used and more importantly distinguishing the different meanings of the term “Sunna”. The study showed that the removal of prepuce only, the form that some Islamic scholars believe it is “Sunna”, does not exist in practice. A very important finding in the context of changing practice.

There is a wide belief in Sudan that inspection of genitalia, especially in young girls would not be accepted. In these studies, we found a high acceptance rate, a finding that should encourage paediatricians, gynaecologists and researchers to include such important clinical data even if dealing with a sensitive issue in the society, such as FGM.

The scarcity of studies on STIs in Sudan could be due to the sensitivity of the topic in an Islamic society. Again we found high acceptance rate for testing for STIs among the respondents.

8.3 HEALTH CONSEQUENCES OF GENITAL MUTILATION ON THE GIRL CHILD

FGM is a fundamental violation of girls' and women's rights, whether there are complications to the operation or not. Most of the existing prevalence rates and complications of FGM were based on self-reports by adult women. To our knowledge there are only few studies published that were carried out on girls.

All forms of FGM cause harm to the girl child. Starting from the time of the operation where most of the girls get in to a state of shock caused by the severe pain, exhaustion of screaming and the psychological trauma. Following genital mutilation, the adverse effects continues with the girl all through her life. Early complications include among others; bleeding, failure to heal, tetanus, abscess formation, keloid formation and cysts (44,49–51).

In our study we did not encounter any signs of immediate complication of FGM. Only few respondents reported immediate complication. Although a previous study in Sudan have shown that more than 70% of girls were bed ridden for one week or more following the FGM operation and in spite of this, only five of the 52 girls with FGM (10%) in that study, were said to have had immediate complications. One of them had urine retention and fever, and the others had shock with unconsciousness, fever, wound infection and urine retention (106). The same study revealed an extreme under reporting of urogenital symptoms. Even though genital inspection should often be a part of the routine examination of paediatric patients, this is rarely done in clinical practice in Sudan, possibly because it is believed to be too sensitive. This reluctance to ask about symptoms from the genital tract and to inspect the genitals might lead to the true diagnosis being missed, which in turn might increase the risk of further complications.

8.3.1 Short term sequelae; urinary and renal complications

Theoretically any form of FGM that involves suturing or apposition of the two sides to heal together is similar to labial adhesion as risk factor for a symptomatic bacteruria and recurrent urinary tract infections, which are known risk factors of kidney disease

103].

Both study I and study V have shown that reporting repeated subjective symptoms of UTIs was significantly higher among cases than controls.

Previous research in Sudan have indicated a possible relation between FGM and urinary tract infection (106), which could be because the anatomical changes due to FGM do not allow the normal flow of urine which leads to accumulation of leucocytes. One interesting finding in study V is that there was an association between CKD and FGM (independent of form) rather than the extent of the procedure. One possible explanation could be that urethral meatus is frequently injured and sutured during FGM operation, resulting in scarring and urethral obstruction. This was especially found in milder forms in previous studies (31). Another study in The Gambia showed that type I was the most common type of FGM, and it was associated with high percentage of complications, especially uro-genital infections (119).

There was also a higher rate of reporting immediate complication among the cases in study V, than among the controls. A finding that may be influenced by recall bias as we discussed earlier, bearing in mind that most of the literature on immediate complication is based on self-reports by adult women and the relatively shorter time interval between our observation and the operation.

The age of the operation didn't differ between cases and controls, but cases with CKD seem to have longer time interval between the operation and our observation. This could be because cases have longer exposure to repeated urinary complication caused by the anatomical changes of FGM. Recent research in Egypt has shown a high prevalence of lower urinary tract symptoms among women how have undergone FGM than those how have not, and that these symptoms seem to be more troublesome for those who have undergone the most severe form (120).

Perhaps we should have performed renal biopsies to look for different inflammatory and possibly infectious causes and also dynamic radiological investigation such as micturating cysto-urithrogram (MCUG) to look for reflux. Due to logistical limitations in the present setting, this was not possible in this study. In spite of this limitation in the study, our findings indicate a possible relation between CKD and FGM. Independent of the actual incidence and prevalence, the care of children with CKD imposes a burden on the health care budget of developing and underdeveloped countries like Sudan.

Having in mind the scarcity of studies on the sequelae of FGM on the girl child and the increasing incidence of kidney disease in children in Sudan (unpublished data, noted commonly by practicing paediatricians in Sudan) our results prove clinically important

and indicate the importance of finding out more about uro-genital problems related to FGM in girls.

8.3.2 Sequelae later in life; sexually transmitted infections and primary infertility

The physical damages resulting from FGM, together with the psychological trauma and pain associated with it, can compromise an adult woman's normal sexual life and self-esteem resulting in constant marital problems that can eventually lead to divorce which in a traditional society like Sudan, can jeopardize women's social and economic status and that of their children, thus resulting in poorer families (121).

Study II suggests that FGM does not necessarily increase a woman's risk for sexually transmitted diseases, but it is certainly not protective. In many countries, where FGM is practiced, women who have undergone FGM have similar rates of sexually transmitted infections to those who have not. FGM, however, put women at increased risk of HIV and AIDS (122). Consistent with our findings, a study in Tanzania showed a similar prevalence of STIs among women who had undergone FGM and those who had not (41).

The study shows a low prevalence of STIs, this is comparable with the previous Sudanese studies that showed a low prevalence (98). However, the difference in methods used to test for different STIs makes it difficult to compare between studies. In Sudan, early in the eighties among women coming to a STIs clinic in Khartoum, the prevalence of *C. trachomatis* antibodies was 12.9% (123). Another study among women presenting with vaginal discharges to a gynaecology clinic in Khartoum showed that *N. gonorrhoeae* antibodies were present in 1.4% of cases (124). All these studies show that prevalence of STIs in Sudan is low compared with studies from Sub-Saharan Africa (96).

The study also shows that cases with STIs have severe forms of FGM slightly more often than controls without STIs (85% compared with 78%).

In Nigeria, a previous study showed more episodes of lower abdominal pain in women with type I and type II than women without FGM, which, according to the authors, indicates a higher prevalence of PID among women who have undergone FGM. Vaginal discharge was also more common among circumcised women than among uncircumcised women. Reproductive tract infections in this study were assessed based on women's self-reporting of symptoms, which is less accurate than using standardized laboratory testing method (99).

FGM is known to cause sexual problems not only for women subjected to the practice but also to their husband (125), which theoretically could make him prone to go for extramarital sex. Other factor that may influence the risk of acquiring STIs in Sudan is the traditional long abstinence period up to 6 and 10 weeks post-partum, a period that is usually needed to allow healing of the Re infibulation procedure commonly performed in Sudan after delivery.

Our study indicate that FGM does not seem to be protective against acquiring STIs, which can be used in campaigns against the practice by challenging one of the main reasons to perform FGM, the perceived belief that FGM protects from promiscuity and pre/extramarital sex.

The observed association between FGM and infertility in paper I, is intriguing in a society where childbearing is highly valuable. Our findings indicate an association between severe forms of FGM, involving the labia majora, and primary infertility in Sudan.

We performed laparoscopy to look for tubal pathology rather than HSG. Laparoscopy was the gold standard investigation of infertility in Sudan when the study was conducted. It might be argued that laparoscopy is more invasive but HSG has been shown to have high false positive and high negative findings and laparoscopy would give us information not just on tubal patency but it also allows identification of peritubal adhesions and other pathologies like Tuberculosis and Schistosomiasis. Hysterosalpingo-contrast sonography (HyCoSy) is less invasive and cost effective as a preliminary screening test. It will not, however, provide information on adnexal pathology and in most cases laparoscopy will have to be performed at later stage in the investigation.

It might be argued that endometrial curettage should have been done to enable proper diagnosis of genital Schistosomiasis and tuberculosis. However, these diseases often cause irregular bleeding (126,127), and would thus have been excluded from our study. Even though urinary and genital Schistosomiasis frequently coincide, urinalysis is not sufficient to exclude genital Schistosomiasis, since diagnosis based on a single urine sample misses about one third of cases (128). However, in the absence of clinical findings to indicate the disease (schistosoma ova in the urine, significant haematuria, typical symptoms, or laparoscopic findings) we concluded that genital Schistosomiasis is unlikely to contribute to infertility in the study

Genital tuberculosis is fairly rare, and is usually caused by hematogenous spread from a distant focus, but transmission through a sexual intercourse is also possible (129,130).

It accounts for less than 2% of all tuberculosis (127). Female genital TB usually affects endometrium and fallopian tubes, thus present as infertility, pelvic pain and menstrual irregularity (127,131). In this study we did not control for tuberculosis, but none of the cases had clinical or laparoscopic signs of the disease, so its contribution to infertility would probably be small. Only two cases and three controls had serological markers for *N gonorrhoeae*, which implies that its contribution to primary infertility in Sudan is low. *C trachomatis*, however, seems to contribute to primary infertility in the study population, but the prevalence is low even among cases.

All the known risk factors for primary infertility mentioned above, have been excluded in the study and we have shown that the contribution of sexually transmitted infections to the problem is low. Thus, we conclude that the association noted between FGM and primary infertility is valid and is relevant in clinical practice in Khartoum.

In addition to our finding that the anatomical extent of FGM rather than suturing or closure per se (WHO type III) seems to be associated with primary infertility. We also made an interesting observation that the group of infertile patients with normal laparoscopic findings had similar borderline significance between FGM and primary infertility to the group with adnexal pathology. Thus, the macroscopic changes that can be seen by laparoscopy are not the only factors contributing to infertility. FGM might provoke changes in the whole reproductive system, for instance by altering the local environment and bacterial colonization in the vulva or vagina or by causing low-grade chronic inflammation. The findings of several studies (39,99) show an association between FGM and urinary and genital tract infections. In our study, as we mentioned earlier, more infertile women reported recurrent urinary tract infections than controls, which could indicate disturbances in the local environment.

The age at FGM operation did not differ in the two groups, but cases with adnexal pathology had had FGM for a significantly longer time than cases with normal laparoscopy findings. This observation gives rise to the hypothesis that the macroscopic findings of tubal pathology could represent a later stage of the same process of FGM-induced inflammatory changes invisibly present in infertile cases with normal laparoscopic findings. Alternatively, the FGM operation might start another process, parallel to the inflammation leading to adnexal pathology, causing infertility at an earlier stage.

In the current climate in Sudan, it is even more important than before, to emphasize that our findings of observed association between the severe forms of FGM and primary infertility compared with milder forms should not be used in pro FGM campaigns to

promote the allegedly called “*Sunna*” form or to try to medicalize the practice. It actually, on the contrary, seems that any form of alteration of the normal female genital anatomy or environment leads to structural and physiological changes which in turn will lead to adverse effects in her reproductive life. We have also shown that having undergone FGM, regardless of the type is possibly associated with higher risk of acquiring kidney disease in girls.

In a study based on the demographic health survey 1989/1990 in Sudan, the author noted that women with infibulation and intermediate forms (labia majora is involved in the two forms) of FGM had a significantly higher prevalence of primary infertility than women without FGM (OR 2.76) (132). In 2009 another local study has shown that women with “*Pharaonic*” circumcision (which in the local Sudanese term corresponds to FGM Type III) showed a higher prevalence of primary and secondary infertility than uncircumcised women (133).

A case control study in Egypt, 1988–89, compared 100 infertile cases (a mixed group of both primary and secondary infertility) and 90 fertile controls recruited from a hospital in Alexandria. In spite of the methodological limitations in the study, it showed that there was a tendency that women having undergone excision (type II) had a higher risk of tubal factor infertility than those having undergone clitoridectomy (type I), but the results were not significant (134).

Our findings show a strong positive association between the anatomical extent of FGM and primary infertility. There is theoretical support for the association, and other studies indicating the same association. Thus we conclude this association is true. The association is not only statistically highly significant, but also highly relevant for preventive work against this ancient practice.

In Africa infertility has severe social, psychological and economical implication especially for women who faces risk of divorce or the husband marrying another woman (67). Life without children is perceived not to be worth living as there will be nobody to inherit the family name and properties of the deceased. Many women feel that they shoulder a disproportionate share of the blame for infertility and, by far, face greater social consequences than male partners (86). In a society like Sudan infertile women feel that their voices are not heard and they don’t have power for decisions making within the family. It has been shown that infertile women are often excluded from inheriting property and from any type of financial or social security (76)

9 CONCLUSION

FGM is no longer a cultural practice alone. Rather it has become a phenomenon that cannot be independently evaluated without looking at the social and economic injustice surrounding women and girls. This study indicates high prevalence of FGM in Khartoum, with type III, being the most prevalent form. Parental education, socioeconomic level and religion are important determinants of the practice. The persistence of FGM is due to many complex social, religious, and cultural reasons intrinsically linked to traditional beliefs and values related to women's sexuality.

The reliability of reported form is low, and there is a considerable over reporting of the "Sunna" form. This finding is very important when designing or interpreting epidemiological studies based on self-reports. None of the women or girls in the whole study population in these studies had only the prepuce removed, the form that some promote on religious stands. This finding is very important in the current debate in Sudan.

Although the health consequences of FGM, both physical and psychological, have been extensively studied, the urinary tract complications of the procedure have not been sufficiently addressed in the literature. Furthermore, there is a clear lack of scientific studies on the health consequences of FGM on the girl child

FGM contributes significantly to female morbidity, and we suspect a large share of this does not come to medical attention in Sudan. Health care providers and especially paediatricians in Sudan need to be aware of this.

We have also found a possible relation between CKD and FGM. Having in mind the theoretical background and the previous research findings about urogenital complications of genital mutilation in girls, this finding is not just clinically important but has wider social implications. The observed association between FGM and infertility is intriguing in a society where childbearing is highly valuable. Traditionally FGM was performed to enhance marriageability, but our finding that FGM is a likely cause of infertility challenges this fundamental and traditional motive.

In a religious and traditional society like Sudan, it is imperative that the religious authorities support the campaigns. A common statement of religious leaders in Sudan is still a missing link affecting the efforts for the abandonment of the practice.

It is important for interventionists to remember that the elimination of such an ancient cultural practice will require a lengthy commitment. Any approach that aims to end FGM must include education and economic empowerment of women.

10 RECOMMENDATIONS FOR FURTHER RESEARCH

Findings from this thesis indicate a trend towards milder forms of FGM, Household health surveys in Sudan suggest a decline in prevalence. Further research is needed to identify this decline and to explore to what extent the intention of the guardian in this thesis not to perform FGM will be fulfilled in the future.

Results in this thesis indicate that FGM causes changes to the urogenital tract of young girls, changes that might increase risks for infections causing reproductive complications and urinary tract/ renal complication. Our hypotheses about the actual causative chain between FGM and infertility or CKD still needs to be investigated.

The underlying aetiology of kidney diseases in Sudanese girls needs to be investigated, for instance by performing renal biopsies and radiological investigations. Further research is needed to follow up and clarify the possible association between kidney disease and FGM.

Results from several previous pieces of research have supported the existence of FGM complications in girls. These do, however, not come to the medical attention in Sudan. This necessitates a new way of approaching girls outside the health system in order to fully understand the sequelae of FGM on girls, not just physically but also socially and psychologically.

Today there are many nongovernmental organizations and networks working with ambitions to increase the knowledge and awareness in the Sudanese Society about the negative effects of FGM, trying to promote its abandonment. It is very important that researchers cooperate with these networks to ensure that research results are best used. It would also be interesting to investigate which approach is the most effective to eradicate genital mutilation of girls.

11 ACKNOWLEDGEMENTS

Completing a PhD is truly a marathon event, and I would not have been able to complete this journey without the aid and support of countless people over the past few years.

I would like to gratefully and sincerely thank Dr Lars Almroth for his guidance, understanding, patience, and most importantly, his friendship during my PhD studies. His mentorship was paramount in providing a well-grounded experience consistent my long-term career goals. He encouraged me to not only grow as researcher but also as independent thinker. For everything you've done for me, Lars, I thank you.

I would also like to express my sincere gratitude to my co supervisor Staffan Bergström for the continuous support of my PhD studies and research. His assistance and guidance helped me in getting my career started on the right foot.

I am very grateful to Dr Mohamed Abdelraheem who coordinated the renal failure study. Thank you for making it possible even when times were difficult.

Besides, I would like to thank my Dear Friends and co-authors Tayseer Idris, Nagla Elhadi, Alia Satti and also thank Dr Mohamed Hashim for his greate help and support in the infertility study.

I would like to thank Prof Elsir Hashim and Dr. Ahlam Ahmed for the great support for the paediatric study. I would also like to thank Prof Gaafar Ibnnauf Sulaiman, the formal director of children's emergency hospital in Khartoum. I am very grateful for his support that made the paediatric study possible.

Prof Saad Elfadil, Prof Mohamed Ahmed Elsheikh and Dr. Abdelrahim Obeid, thank you for the great passion and skilled work in the infertility study.

Dr Isam M. Elkhidir department of Microbiology, University of Khartoum and Dr. Steen Hoffmann, Statens Serum Institut, Copenhagen, Denmark provided support and countless knowledge in microbiology field.

A special acknowledgement goes to Vanja Berggren who has always given me the friendship and the strength that I needed while being away from home. A friend who come all the way from Sweden to Sudan to attend my wedding ceremony is definitely special. Vanja, thanks for providing me with a second home in Sweden! Your hospitality and friendship meant a lot to me.

I could never imagined that I would find such a special group of friends as those I met in Sweden. Nada, Amre and Kamal, thank you for the unforgettable time in Sweden. My special gratitude to Dr Salah Farouk and his family for their kind hospitality in Sweden.

Lena Rolfhamre, thank you for allowing me to be a daughter and providing me with valuable support, hospitality and friendship.

I want to thank many people at IHCAR, Karolinska Institute, especially Gun-Britt Eriksson and Marie- Louise Thomé for administrative assistance and Thomas Mellin for computer support. Thanks also to Gunnar Nordahl for statistical assistance. And many others who made my time in Sweden worthwhile.

The study was partially funded by the Swedish International Development Agency, Sida/SAREC and the Swedish Institute.

Special thanks to my husband Murwan for all the inspiring and motivating conversations. These past several years have not been an easy ride, neither academically nor personally. I truly thank you Murwan for your love and for sticking by my side, in ups and downs time of my life.

The apples of my eyes: Omer and Aseel sorry for all the inconveniences caused while being away in all visits to Sweden and thank you for your endless love and the happiness you brought to my life.

My family has been there for me in different ways. I am very grateful for the support of my sisters and brothers who have been my best friends all my life. Thank you Abeer, Reem, Rania, Mohamed, Ahmed and Musharaf for the countless support.

My Mum Munira Ibrahim, I would like to thank you for the sincere encouragement and inspiration throughout my research work and lifting me uphill this phase of life. You gave me the strength to continue when I thought I would never be able to do it without my late father. I owe everything to them all.

Finally, thanks to anyone who have knowingly or unknowingly helped me in the successful completion of this project.

12 REFERENCES

1. United Nations General Assembly, Convention on the Rights of the Child [Internet]. 1989 [cited 2013 Sep 24]. Available from: <http://www.amnestyusa.org/our-work/issues/children-s-rights/convention-on-the-rights-of-the-child>
2. Convention on the Elimination of All Forms of Discrimination against Women art 5 in United Nations General Assembly ed 1979. CEDAW 29th Session [Internet]. 2003 [cited 2013 Sep 24]. Available from: <http://www.un.org/womenwatch/daw/cedaw/text/econvention.htm#article5>
3. Kalev HD. Cultural rights or human rights: The case of female genital mutilation. *SEX ROLES*. 2004;51(5-6):339–48.
4. United States Department of State, Sudan: Report on Female Genital Mutilation (FGM) or Female Genital Cutting (FGC). [Internet]. 2001 Jun. Available from: <http://www.refworld.org/docid/46d5787dc.htm>
5. WHO | Female genital mutilation [Internet]. 2013. Available from: <http://www.who.int/mediacentre/factsheets/fs241/en/index.html>
6. ELDAREER A. EPIDEMIOLOGY OF FEMALE CIRCUMCISION IN THE SUDAN. *Trop Doct*. 1983;41–5.
7. SOAT. Female Genital Mutilation in Sudan. London: Sudan Organization Against torture. [Internet]. 1999. Available from: <http://www.soatsudan.org/public/othersources.asp>
8. Danmark. Eliminating female genital mutilation: an interagency statement. Geneva: World Health Organization; 2008.
9. WHO | Classification of female genital mutilation [Internet]. WHO. [cited 2013 Sep 23]. Available from: <http://www.who.int/reproductivehealth/topics/fgm/overview/en/>
10. Islam MM, Uddin MM. Female Circumcision in Sudan: Future Prospects and Strategies for Eradication. *Int Fam Plan Perspect*. 2001 Jun;27(2):71–6.
11. Almroth-Berggren LA. REINFIBULATION AMONG WOMEN IN A RURAL AREA IN CENTRAL SUDAN. *Health Care Women Int*. 2001;22(8):711–21.
12. Rushwan H. Female circumcision in the Sudan: prevalence, complications, attitudes and change. Khartoum: Faculty of Medicine, University of Khartoum, Sudan; 1983.
13. Sami IR. Female circumcision with special reference to the Sudan. *Ann Trop Paediatr*. 1986 Jun;6(2):99–115.
14. Berggren V. Female genital mutilation: studies on primary and repeat female genital cutting. [Stockholm]; 2005.
15. Rushwan H. Female genital mutilation (FGM) management during pregnancy, childbirth and the postpartum period. *Int J Gynaecol Obstet Off Organ Int Fed Gynaecol Obstet*. 2000 Jul;70(1):99–104.
16. Ahmed M. Abdel Magied, El Balah A. Sulima, Dawood M. Kawther. Re-circumcision (R.C.): The Hidden Devil of Female Genital Mutilation — Case

- Study on the Perception, Attitudes and Practices Of Sudanese Women. *Ahfad J Women Change*. 2000 Jun;17(1).
17. El Dareer A. *Woman, why do you weep?: circumcision and its consequences*. London : Westport, Conn., U.S.A: Zed Press ; U.S. distributor, L. Hill; 1982.
 18. Darby R, Svoboda JS, Hobbes T, Rahman A, Toubia N. A rose by any other name? Rethinking the similarities and differences between male and female genital cutting. *Med Anthropol Q*. 2007;21(3):301–23.
 19. Lewnes A, UNICEF, Innocenti Research Centre. *Changing a harmful social convention, female genital mutilation/cutting*. Florence, Italy: UNICEF Innocenti Research Center; 2005.
 20. Braddy CM, Files JA. Female genital mutilation: Cultural awareness and clinical considerations. *J Midwifery Womens Health*. 2007 Apr;52(2):158–63.
 21. United Nations Population Fund. *The state of world population*. New York: United Nations Population Fund; 1997.
 22. Burki T. Reports focus on female genital mutilation in Iraqi Kurdistan. *Lancet*. 2010 Mar;375(9717):794–794.
 23. Project Embera-wera: An experience of cultural change to eradicate female genital mutilation in Colombia – Latin America [Internet]. [cited 2013 Sep 11]. Available from: <http://unfpa.org.co/uploadUNFPA/file/proyectoembera.pdf>
 24. Budiharsana, M. Female circumcision in Indonesia: Extent, implications and possible interventions to uphold women’s health rights - Indonesia_FGM.pdf [Internet]. 2003 Sep. Available from: http://www.popcouncil.org/pdfs/frontiers/reports/Indonesia_FGM.pdf
 25. Rashid A.K. The Practice Of Female Genital Mutilation Among The Rural Malays In North Malaysia. *Internet J Third World Med*. 2010;9(1).
 26. Jaffer YA, Afifi M, Al Ajmi F, Alouhaishi K. Knowledge, attitudes and practices of secondary-school pupils in Oman: II. reproductive health. *East Mediterr Heal J Rev Santé Méditerranée Orient Al-Majallah Al-Şihhīyah Li-Sharq Al-Mutawassit*. 2006 Mar;12(1-2):50–60.
 27. Childinfo.org: Statistics by Area - Female genital mutilation/cutting - Progress [Internet]. 2013 [cited 2013 Sep 11]. Available from: http://www.childinfo.org/fgmc_progress.html
 28. WHO | Female genital mutilation and other harmful practices [Internet]. 2013 [cited 2013 Sep 11]. Available from: http://www.who.int/reproductivehealth/topics/fgm/fgm_trends/en/
 29. UNICEF. *Female genital mutilation/cutting: a statistical overview and exploration of the dynamics of change*. 2013.
 30. El Dareer A. Attitudes of Sudanese people to the practice of female circumcision. *Int J Epidemiol*. 1983 Jun;12(2):138–44.
 31. El Dareer A. Complications of female circumcision in the Sudan. *Trop Doct*. 1983 Jul;13(3):131–3.
 32. Gerais AS. *Female Genital Mutilation (FGM) in the Sudan: A Community Based Study*: 2001;

33. Almroth L., Almroth-Berggren V. a community based study on the change of practice of female genital mutilation in a Sudanese village. *Int J Gynecol Obstet.* 2001;74:179–85.
34. Berggren V, Salam G, Bergstrom S, Johansson E, Edberg A. An explorative study of Sudanese midwives' motives, perceptions and experiences of re-infibulation after birth. *MIDWIFERY.* 2004;20(4):299–311.
35. Shell-Duncan B, Hernlund Y. *Female "circumcision" in Africa: Culture, Controversy, and Change.* Lynne Rienner Publishers; 2000.
36. Asali A, Khamaysi N, Aburabia Y, Letzer S, Halihal B, Sadosky M, et al. Ritual female genital surgery among Bedouin in Israel. *Arch Sex Behav.* 1995 Oct;24(5):571–5.
37. Winkel E. A Muslim perspective on female circumcision. *Women Health.* 1995;23(1):1–7.
38. Al-Sabbagh, ML. *Islamic Ruling on Male and Female Circumcision in The Right Path to Health, Health education through religion, WHO, Regional Office for the Eastern Mediterranean, 1996, [Internet]. 1996 [cited 2013 Aug 21]. Available from: <http://applications.emro.who.int/dsaf/dsa54.pdf>*
39. Morison L, Scherf C, Ekpo G, Paine K, West B, Coleman R, et al. The long-term reproductive health consequences of female genital cutting in rural Gambia: a community-based survey. *Trop Med Int Heal TM IH.* 2001 Aug;6(8):643–53.
40. Klouman E, Manongi R, Klepp KI. Self-reported and observed female genital cutting in rural Tanzania: associated demographic factors, HIV and sexually transmitted infections. *Trop Med Int Health.* 2005;10(1):105–15.
41. Msuya SE, Mbizvo E, Hussain A, Sundby J, Sam NE, Stray-Pedersen B. Female genital cutting in Kilimanjaro, Tanzania: changing attitudes? *Trop Med Int Heal TM IH.* 2002 Feb;7(2):159–65.
42. Snow RC, Slanger TE, Okonofua FE, Oronsaye F, Wacker J. Female genital cutting in southern urban and peri-urban Nigeria: self-reported validity, social determinants and secular decline. *Trop Med Int Heal TM IH.* 2002 Jan;7(1):91–100.
43. Adinma JI. Current status of female circumcision among Nigerian Igbos. *West Afr J Med.* 1997 Dec;16(4):227–31.
44. Dirie MA, Lindmark G. The risk of medical complications after female circumcision. *East Afr Med J.* 1992 Sep;69(9):479–82.
45. WHO | Health complications of female genital mutilation [Internet]. 2013 [cited 2013 Sep 24]. Available from: http://www.who.int/reproductivehealth/topics/fgm/health_consequences_fgm/en/
46. Behrendt A, Moritz S. Posttraumatic stress disorder and memory problems after female genital mutilation. *Am J PSYCHIATRY.* 2005;162(5):1000–2.
47. Pereda N, Arch M, Perez-Gonzalez A. A case study perspective on psychological outcomes after female genital mutilation. *J Obstet Gynaecol.* 2012 Aug;32(6):560–5.
48. Nour NM. Female genital cutting: Clinical and cultural guidelines. *Obstet Gynecol Surv.* 2004 Apr;59(4):272–9.

49. Eke N, Nkanginieme KEO. Female genital mutilation and obstetric outcome. *LANCET*. 2006;367(9525):1799–800.
50. Ekenze SO, Ezegwui HU, Adiri CO. Genital lesions complicating female genital cutting in infancy: a hospital-based study in south-east Nigeria. *Ann Trop Paediatr*. 2007;27(4):285–90.
51. Pereira N, Guilfoil DS. Excision of an Enlarging Vaginal Epidermal Inclusion Cyst During Pregnancy: A Case Report. *J Low Genit Tract Dis*. 2012 Jul;16(3):322–4.
52. Ibrahim A, Rasch V, Pukkala E, Aro AR. Cervical cancer risk factors and feasibility of visual inspection with acetic acid screening in Sudan. *Int J Womens Heal*. 2011;3:117–22.
53. Berggren V, Gottvall K, Isman E, Bergström S, Ekéus C. Infibulated women have an increased risk of anal sphincter tears at delivery: a population-based Swedish register study of 250 000 births. *Acta Obstet Gynecol Scand*. 2013 Jan;92(1):101–8.
54. Bjälkander O, Bangura L, Leigh B, Berggren V, Bergström S, Almroth L. Health complications of female genital mutilation in Sierra Leone. *Int J Womens Heal*. 2012;4:321–31.
55. Ali AAA, Okud A, Mohammed AA, Abdelhadi MA. Prevalence of and factors affecting female genital mutilation among schoolgirls in Eastern Sudan. *Int J Gynaecol Obstet Off Organ Int Fed Gynaecol Obstet*. 2013 Mar;120(3):288–9.
56. Sudan 1989/1990: results from the Demographic and Health Survey. *Stud Fam Plann*. 1992;23(1):66–70.
57. Sudan Household Health Survey. Sudanese Central Bureau of Statistics/Southern Sudan Commission for Census, Statistics and Evaluation, Sudan; 2006.
58. Almroth L. Genital mutilation of girls in Sudan: community- and hospital-based studies on female genital cutting and its sequelae. [Stockholm]; 2005.
59. Dyer SJ. International estimates on infertility prevalence and treatment seeking: potential need and demand for medical care. *Hum Reprod Oxf Engl*. 2009 Sep;24(9):2379–2380; author reply 2380–2383.
60. Gurunath S, Pandian Z, Anderson RA, Bhattacharya S. Defining infertility--a systematic review of prevalence studies. *Hum Reprod Update*. 2011 Apr 14;17(5):575–88.
61. Infections, pregnancies, and infertility: perspectives on prevention. World Health Organization. *Fertil Steril*. 1987 Jun;47(6):964–8.
62. Fertility: assessment and treatment for people with fertility problems (update) National Collaborating Centre for Women's and Children's Health Commissioned by the National Institute for Health and Clinical Excellence. RCOG Press R. Coll. Obstet. Gynaecol. 2012.
63. Forti G, Krausz C. Clinical review 100: Evaluation and treatment of the infertile couple. *J Clin Endocrinol Metab*. 1998 Dec;83(12):4177–88.
64. Larsen U. Primary and secondary infertility in sub-Saharan Africa. *Int J Epidemiol*. 2000 Apr;29(2):285–91.

65. Sundby J, Mboge R, Sonko S. Infertility in the Gambia: frequency and health care seeking. *Soc Sci Med* 1982. 1998 Apr;46(7):891–9.
66. Gerais AS, Rushwan H. Infertility in Africa. *Popul Sci Cairo Egypt*. 1992 Jul;12:25–46.
67. Meheus A, Reniers J, Colletet M. Determinants of infertility in Africa. *Afr J Sex Transm Dis*. 1986 Oct;2(2):31–5.
68. Cates W, Farley TM, Rowe PJ. Worldwide patterns of infertility: is Africa different? *Lancet*. 1985 Sep 14;2(8455):596–8.
69. Elussein EA, Magid YM, Omer MM, Adam I. Clinical patterns and major causes of infertility among Sudanese couples. *Trop Doct*. 2008 Oct;38(4):243–4.
70. Philip Teg-Nefaah Tabong. Understanding the Social Meaning of Infertility and Childbearing: A Qualitative Study of the Perception of Childbearing and Childlessness in Northern Ghana. *PLoS One* [Internet]. 2013;8(1). Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3546987/#pone.0054429-National1>
71. Mother or nothing: the agony of infertility. *Bull World Health Organ*. 2010 Dec;88(12):877–953.
72. Osman AA. Management of Infertility within Primary Health Care Program in Sudan. *Asian J Sci Res*. 2011 Feb 1;4(2):158–64.
73. Abdalla NM. Epidemiology of Infertility in Gezira Region, Central of Sudan. *Res J Med Sci*. 2011 Jan 1;5(1):56–60.
74. Fidler AT, Bernstein J. Infertility: from a personal to a public health problem. *Public Health Rep*. 1999;114(6):494–511.
75. Mohammed El Imam M. Ahmed. Mustafa Omran Mansour KEK. Semen analysis of infertile Sudanese males in Gezira state central Sudan. *Sudan J Public Heal*. 2009;4:340–4.
76. Okonofua FE, Harris D, Odebiyi A, Kane T, Snow RC. The social meaning of infertility in Southwest Nigeria. 2004 May 19 [cited 2013 Sep 17]; Available from: <https://digitalcollections.anu.edu.au/handle/1885/41267>
77. Dechanet C, Anahory T, Mathieu Daude JC, Quantin X, Reyftmann L, Hamamah S, et al. Effects of cigarette smoking on reproduction. *Hum Reprod Update*. 2011 Feb;17(1):76–95.
78. Brydøy M, Fosså SD, Dahl O, Bjørro T. Gonadal dysfunction and fertility problems in cancer survivors. *Acta Oncol Stockh Swed*. 2007;46(4):480–9.
79. Sloboda DM, Hickey M, Hart R. Reproduction in females: the role of the early life environment. *Hum Reprod Update*. 2011 Apr;17(2):210–27.
80. Hoffman L, Chan K, Smith B, Okolo S. The value of saline salpingosonography as a surrogate test of tubal patency in low-resource settings. *Int J Fertil Womens Med*. 2005 Jun;50(3):135–9.
81. Weström L, Joesoef R, Reynolds G, Hagdu A, Thompson SE. Pelvic inflammatory disease and fertility. A cohort study of 1,844 women with laparoscopically verified disease and 657 control women with normal laparoscopic results. *Sex Transm Dis*. 1992 Aug;19(4):185–92.

82. Mårdh P-A. Tubal factor infertility, with special regard to chlamydial salpingitis. *Curr Opin Infect Dis.* 2004 Feb;17(1):49–52.
83. Kanal P, Sharma S. Study of Primary Infertility in females by Diagnostic Laparoscopy. *Internet J Medicalupdate.* 2006;1(2):7–9.
84. Malek-Mellouli M, Gharbi H, Reziga H. The value of sonohysterography in the diagnosis of tubal patency among infertile patients. *Tunis Médicale.* 2013 Jun;91(6):387–90.
85. De Felice C, Rech F, Marini A, Stagnitti A, Valente F, Cipolla V, et al. Magnetic resonance hysterosalpingography in the evaluation of tubal patency in infertile women: an observational study. *Clin Exp Obstet Gynecol.* 2012;39(1):83–8.
86. Fledderjohann JJ. “Zero is not good for me”: implications of infertility in Ghana. *Hum Reprod Oxf Engl.* 2012 May;27(5):1383–90.
87. Baron EM, Denmark FL. An Exploration of Female Genital Mutilation. *Ann N Y Acad Sci.* 2006;1087(1):339–55.
88. Kokotos F, Adam HM. Vulvovaginitis. *Pediatr Rev.* 2006 Mar 1;27(3):116–7.
89. O’Brien TJ. Paediatric vulvovaginitis. *Australas J Dermatol.* 1995;36(4):216–8.
90. Nelson textbook of pediatrics. 19th ed. Philadelphia, PA: Elsevier/Saunders; 2011.
91. Lapidus J, Anderson EC, Petrone AF. URinary-tract infection in children. *JAMA.* 1966 Jan 24;195(4):248–53.
92. WHO | Sexually transmitted infections (STIs), Fact sheet N°110 [Internet]. 2013 [cited 2013 Sep 2]. Available from: <http://www.who.int/mediacentre/factsheets/fs110/en/>
93. Van Zandvoort H, de Koning K, Gerrits T. Viewpoint: medical infertility care in low income countries: the case for concern in policy and practice. *Trop Med Int Heal TM IH.* 2001 Jul;6(7):563–9.
94. Machungo F, Zanconato G, Persson K, Lind I, Jorgensen B, Herrmann B, et al. Syphilis, gonorrhoea and chlamydial infection among women undergoing legal or illegal abortion in Maputo. *Int J STD AIDS.* 2002 May;13(5):326–30.
95. Samucidine M, Folgosa E, Mondlane C, Bergstorm S. Infertile Women in Developing Countries at Potentially High Risk of HIV Transmission. *Afr J Reprod Health.* 1999;3(1):98–102.
96. Samucidine M, Barreto J, Lind I, Mondlane C, Bergstrom S. Serological Evidence of Gonorrhoea among Infertile and Fertile Women in Rural Mozambique. *Afr J Reprod Health.* 1999;3(2):102–5.
97. Duncan ME, Reimann K, Tibaux G, Pelzer A, Mehari L, Lind I. Seroepidemiological study of gonorrhoea in Ethiopian women. 1. Prevalence and clinical significance. *Genitourin Med.* 1991 Dec;67(6):485–92.
98. Ortashi OM, El Khidir I, Herieka E. Prevalence of HIV, syphilis, Chlamydia trachomatis, Neisseria gonorrhoea, Trichomonas vaginalis and candidiasis among pregnant women attending an antenatal clinic in Khartoum, Sudan. *J Obstet Gynaecol J Inst Obstet Gynaecol.* 2004 Aug;24(5):513–5.

99. Okonofua F e., Larsen U, Oronsaye F, Snow R c., Slanger T e. The association between female genital cutting and correlates of sexual and gynaecological morbidity in Edo State, Nigeria. *BJOG Int J Obstet Gynaecol.* 2002;109(10):1089–96.
100. Shandall AA. Circumcision and infibulation of females: a general consideration of the problem and a clinical study of the complications in Sudanese women. *Sudan Med J.* 1967;5(4):178–212.
101. Saadeh SA, Mattoo TK. Managing urinary tract infections. *Pediatr Nephrol Berl Ger.* 2011 Nov;26(11):1967–76.
102. Simon C. Urinary Tract Infection in Childhood. *InnovAiT RCGP J Assoc Train.* 2008;1(1):69–72.
103. Mishra OP, Abhinay A, Prasad R. Urinary infections in children. *Indian J Pediatr.* 2013 Oct;80(10):838–43.
104. Wald E. Urinary tract infections in infants and children: a comprehensive overview. *Curr Opin Pediatr.* 2004 Feb;16(1):85–8.
105. Starr NB. Labial adhesions in childhood. *J Pediatr Heal Care.* 1996;10(1):26–7.
106. Almroth L, Bedri H, El Musharaf S, Satti A, Idris T, Hashim MS, et al. Urogenital complications among girls with genital mutilation: a hospital-based study in Khartoum. *Afr J Reprod Heal.* 2005 Aug;9(2):118–24.
107. Warady BA, Chadha V. Chronic kidney disease in children: the global perspective. *Pediatr Nephrol.* 2007 Dec;22(12):1999–2009.
108. Ali E, Abdelraheem MB, Mohamed RM, Hassan EG, Watson AR. Chronic renal failure in Sudanese children: aetiology and outcomes. *Pediatr Nephrol.* 2009;349–53.
109. Anochie I, Eke F. Chronic renal failure in children: a report from Port Harcourt, Nigeria (1985-2000). *Pediatr Nephrol.* 2003 Jul;18(7):692–5.
110. Miller ME, Williams JA. Chronic renal failure in Jamaican children--an update (2001-2006). *West Indian Med J.* 2009 Jun;58(3):231–4.
111. Central Intelligence Agency, CIA. The World Factbook [Internet]. [cited 2013 Sep 30]. Available from: <https://www.cia.gov/library/publications/the-world-factbook/fields/2223.html>
112. Sudan's Spreading Conflict (II): War in Blue Nile Crisis Group Africa Report N°204,. 2013.
113. Cottingham J, Kismodi E. Protecting girls and women from harmful practices affecting their health: Are we making progress? *Int J Gynaecol Obstet.* 2009 Aug;106(2):128–31.
114. Ahlberg BM, Krantz I, Lindmark G, Warsame M. "It's Only a Tradition": Making Sense of Eradication Interventions and the Persistence of Female "Circumcision" within a Swedish Context. *Crit Soc Policy.* 2004 Feb 1;24(1):50–78.
115. Bjälkander O. Female genital mutilation in Sierra Leone. 2013 Mar 13 [cited 2013 Sep 17]; Available from: <http://publications.ki.se/xmlui/handle/10616/41373>

116. Gilbert D. For the sake of purity (and control). Female genital mutilation. *Links New York N.* 1993;9(5):6–8, 30.
117. Cloudsley A. *Women of Omdurman: Life, Love, and the Cult of Virginity.* St. Martin's Press; 1984.
118. Yasin BA, Al-Tawil NG, Shabila NP, Al-Hadithi TS. Female genital mutilation among Iraqi Kurdish women: a cross-sectional study from Erbil city. *BMC Public Health.* 2013;13(1):809.
119. Kaplan A, Hechavarría S, Martín M, Bonhoure I. Health consequences of female genital mutilation/cutting in the Gambia, evidence into action. *Reprod Heal.* 2011;8:26.
120. Amin MM, Rasheed S, Salem E. Lower urinary tract symptoms following female genital mutilation. *Int J Gynecol Obstet.* 2013 Oct;123(1):21–3.
121. Nafisa Bedri. *Ending FGM/C through Evidence Based Advocacy in Sudan-*, AUW. 2012.
122. Diouf K, Nour N. Female Genital Cutting and HIV Transmission: Is There an Association? *Am J Reprod Immunol.* 2013;69:45–50.
123. Omer EE, Forsey T, Darougar S, Ali MH, el-Naeem HA. Seroepidemiological survey of chlamydial genital infections in Khartoum, Sudan. *Genitourin Med.* 1985 Aug 1;61(4):261–3.
124. Rushwan H. Etiologic factors in pelvic inflammatory disease in Sudanese women. *Am J Obstet Gynecol.* 1980 Dec 1;138(7 Pt 2):877–9.
125. Almroth L, Almroth-Berggren V, Hassanein OM, Al-Said SS, Hasan SS, Lithell UB, et al. Male complications of female genital mutilation. *Soc Sci Med* 1982. 2001 Dec;53(11):1455–60.
126. Wacker J, Zida A, Sitz C, Schweinfurth D, Briegel J, Hüser A, et al. Female genital mutilation and female genital schistosomiasis-bourouwel, the worm: Traditional belief or medical explanation for a cruel practice? *Midwifery.* 2013 Aug;29(8):e73–e77.
127. R N Qureshi. Female genital Tuberculosis Revisted. *J Pak Med Assoc.* 2001;
128. Poggensee G, Kiwelu I, Saria M, Richter J, Krantz I, Feldmeier H. Schistosomiasis of the lower reproductive tract without egg excretion in urine. *Am J Trop Med Hyg.* 1998 Nov 1;59(5):782–3.
129. Angus BJ, Yates M, Conlon C, Byren I. Cutaneous Tuberculosis of the Penis and Sexual Transmission of Tuberculosis Confirmed by Molecular Typing. *Clin Infect Dis.* 2001 Dec 1;33(11):e132–e134.
130. Dragica Pešut, Jelena Stojši. Female genital tuberculosis – a disease seen again in Europe. Clinical Center of Serbia, Institute of Lung Diseases and Tuberculosis, Belgrade;
131. Sachan R, Patel ML, Gupta P, Verma AK. Genital tuberculosis with variable presentation: a series of three cases. *Case Reports.* 2012 Aug 27;2012(27 1).
132. Larsen U. The effects of type of female circumcision on infertility and fertility in Sudan. *J Biosoc Sci.* 2002 Jul;34(3):363–77.

133. D.S. Khalifa, M.A. Ahmed. Reviewing infertility care in Sudan: socio-cultural, policy and ethical barriers. *Facts Views Vis OBGYN J.* 2012;53–8.
134. Inhorn MC, Buss KA. Infertility, infection, and iatrogenesis in Egypt: The anthropological epidemiology of blocked tubes. *Med Anthropol.* 1993;15(3):217–44.

13 APPENDIX

Data collection form for Paper I Infertile case

Recruited from centre KTH Soba

Name

Age

Address

Phone

Religion

Tribe

Socio-economic level: low medium high

Total number of years in school (from primary including university): _____

Profession

Married since

Husband's age

Husband's total number of years in school (from primary including university): _____

Husband's profession

Inclusion criteria (please tick)

Seeking medical care for primary infertility?

Less than or equal to 35 years of age?

Regular sexual intercourse for a minimum of two years?

Normal menstrual cycle for the last one year?

Never been pregnant?

Never previous abdominal surgery (including laparoscopy)?

Never used intra-uterine device?

Not used hormonal contraceptives (tablets or injections) for the last two years?

Information on this page filled out by Dr.....date.....

History

Circumcised?	Yes	No		
Age at circumcision?	___	If not certain range: __		
Reported form of circumcision	Type 1	Type 2	Type 3	Other
Fever after the circumcision?	Yes	No	Don't remember	
Seek medical care after circumci	Yes	No	Don't remember	
	Yes	No	Don't remember	
Admitted after circumcision?				
Cause of seeking care/admission:				
History of UTI?	Yes	No		
Number of UTI episodes?	0	1-3	>3	
Age at menarche?	___			
Kata/..			

Data collection form for Paper I

Infertile case

Regular?	Yes	No
Primary dysmenorrhoea?	Yes	No
Secondary dysmenorrhoea?	Yes	No
Menorrhagia	Yes	No
Metrorrhagia	Yes	No

Examination

Weight: _____ kg

Height: _____ cm

Observed form of circumcission

Type 1	Type 2	Type 3	Other
--------	--------	--------	-------

<u>Anatomy:</u>	Untouched	Partially removed	Totally removed	Sides stitched together
Clitoris				
Labiae minora				
Labiae majora				

Other findings (e.g. fenestrations of infibulation, inclusion cysts):

Previously performed investigations (if available)

ULTRASOUND?	Yes	No
If yes, specify findings:		
HSG? If yes, specify below:	Yes	No
Right tubal blockage	Yes	No
Left tubal blockage	Yes	No
Other abnormal findings:	Yes	No
Specify:		
HORMONAL PROFILE	Yes	No
Test :	Result (normal/abnormal):	
D & C	Yes	No
If yes specify findings:		

Information filled out by Dr..... date.....

Laparoscopy

Performed date:		by Dr:	
Right tube	patent	blocked	
	no adhesions	peritubal adhesions	
Right ovary	normal	abnormal	
Left tube	patent	blocked	
	no adhesions	peritubal adhesions	
Left ovary	normal	abnormal	
Other laparoscopy findings	Yes	No	
CONCLUSION tubal factor infertility	Yes	Possible	No

Data collection form for Paper I

Infertile case

Laboratory investigations

INVESTIGATION	RESULT	DATE	SIGNATURE
Hb			
Blood group			
Urine analysis	Pus cells RBC Albumine Glucose		
Urine deposits of ova bilharziasis	Yes No		
Semen analysis	Normal Abnormal		
Chlamydia serology	+ ve -ve titer		
Gonorrhoea serology	+ ve -ve titer		
Syphlis serology	+ ve -ve titer		

Treatment/referral

Any treatment given for free based on laboratory findings?	Yes	No
Diagnosis	Drug	Prescribed by Date
Any Referral (for instance infertility clinic)?	Yes	No
If yes, specify:	By Dr	Date

Complications

Any complications due to laparoscopy?	Yes	No
Diagnosis:	Number of days admitted:	
Cause:		
Treatment		
Outcome:	Date/Dr	
Other complications:		

Data collection form for Paper I
 control
 Laboratory investigations

INVESTIGATION	RESULT	DATE	SIGNATURE
Hb			
Blood group			
Urine analysis	Pus cells RBC Albumine Glucose		
Urine deposits of ova bilharziasis	Yes No		
Chlamydia serology	+ ve -ve titer		
Gonorrhoea serology	+ ve -ve titer		
Syphlis serology	+ ve -ve titer		

Treatment/referral

Any treatment given for free based on laboratory findings?	Yes	No
Diagnosis	Drug	Prescribed by Date
Any Referral (for instance TB-treatment, infertility clinic)?	Yes	No
If yes, specify:	By Dr	Date

Data collection form Paper III

Case NUMBER: _____

Date: _____

Doctor: _____

1. Personal data

- 1.1 Age _____ 1.2 Tribe _____ 1.3 Originally from : _____ 1.4 Residence _____ since: _____
- 1.5 Religion: Muslim Christian other:
- 1.6 Attend school regularly? YES NO If yes, since age: _____
- 1.7 Mother's age _____ 1.10 Father's age _____
- 1.8 Mother's years in school _____ 1.11 Father's years in school _____
- 1.9 Mother's profession _____ 1.12 Father's profession _____
- 1.13 Socio-economic level: low medium high
- 1.14 Informant: mother father grandmother grandfather aunt
- 1.15 Complaints (reason to come): _____

2. History:

- 2.1 History of UTI no 1 2-3 4-5 >5
- 2.2 Previous history of seeking medical treatment/advice regarding genitalia YES NO
- 2.3 History of symptoms from uro-genital tract:
- dysurea itching discharge loin pain recurrent abdominal pain others:

3. Questions about female circumcision

- 3.1 Circumcised? YES NO 3.2 If no: intention to circumcise? YES NO Don't know _____ years
- 3.3 If yes: at what age: _____ years
- 3.4 Form of circumcision: Sunna Intermediate Pharaonic Other:
- 3.5 Performed by: doctor trained midwife TBA Medical assistant Other:
- 3.6 How many days bedridden after the operation _____
- 3.7 Immediate complications:
- Bleeding Fever Wound infection urine retention Other (specify): _____
- 3.8 Seek medical care because of complication YES NO
- 3.9 Health care provider: doctor trained midwife TBA Medical assistant Other:

4. Genital Inspection

- 4.1 Acceptance: Accept Don't accept
- Findings:
- 4.2 Clitoris: untouched partially removed totally removed
- 4.3 Labia minora untouched partially removed totally removed stitched
- 4.4 Labia majora untouched partially removed totally removed stitched
- 4.5 If stitched, size of opening left: 1mm 5mm 1cm normal
- 4.6 Abnormal findings: inclusion cysts discharge infection other:

5. Diagnoses:

- Diagnoses:
- 5.1 _____ 5.1.1 Relation to FGM: YES NO possibly
- 5.2 _____ 5.2.1 Relation to FGM: YES NO possibly

Data collection form Paper V

RENAL FAILURE NUMBER: _____

Date: _____

Doctor: _____

Chronic renal failure

End stage renal failure

Hospital: Soba

Dr Salma dialysis centre

CEH

1. Personal data

1.1 Age____ 1.2 Tribe_____ 1.3 Originally from : _____ 1.4 Residence_____ since: _____

1.5 Religion: Muslim Christian other:

1.6 Attend school regularly? YES NO If yes, since age: _____

1.7 Mother's age____

1.10 Father's age__

1.8 Mother's years in school____

1.11 Father's years in school__

1.9 Mother's profession_____

1.12 Father's profession_____

1.13 Socio-economic level: low medium high

1.14 Informant: mother father grandmother grandfather aunt

other:

1.15 Complaints (reason to come): _____

5. Lab/investigations

5.1.1 height _____

5.1.2 weight____

5.2 Urinalysis

5.3 renal function

5.4

ivu

5.2.1 pus cells ____

5.3.1 urea

5.2.2 rbc ____

5.3.2 creatinine

5.2.3 casts ____

5.2.4 ova ____

5.5 Ultrasound YES NO

5.5.1 residual urine ____ml

5.5.2 dilatation of urether left ____mm

right ____mm

5.5.3 dilatation of pelvis left ____mm

right ____mm

5.5.4 dilatation of collecting system left ____mm

right ____mm

5.5.5 size of kidneys left ____cm

right ____cm

Data collection form Paper V

2. History:

- 2.1 History of UTI no 1 2-3 4-5 >5
- 2.2 Previous history of seeking medical treatment/advice regarding urinary tract/ genitalia YES NO
- 2.3 Antibiotics previously given against UTI no 1 2-3 4-5 >5
- 2.4 History of symptoms from uro-genital tract:
- dysurea itching discharge loin pain recurrent abdominal pain others:

3. Questions about female circumcision

- 3.1 Circumcised? YES NO
- 3.2 If no: intention to circumcise? YES NO Don't know
- 3.3 If yes: at what age: _____years
- 3.4 Form of circumcision: Sunna Intermediate Pharaonic Other:
- 3.5 Performed by: doctor trained midwife TBA Medical assistant
- 3.6 How many days bedridden after the operation _____
- 3.7 Immediate complications: Bleeding Fever Wound infection
- urine retention Other (specify):
- 3.8 Seek medical care because of complication YES NO
- 3.9 Health care provider: doctor trained midwife TBA Medical assistant Other:

4. Genital Inspection

- 4.1 Acceptance: Accept Don't accept

Findings:

- 4.2 Clitoris: untouched partially removed totally removed
- 4.3 Labia minora untouched partially removed totally removed
- stitched
- 4.4 Labia majora untouched partially removed totally removed
- stitched
- 4.5 Abnormal findings: inclusion cysts discharge infection other:

Informed consent for paper I

Cases

PRIMARY INFERTILITY IN SUDAN

A research collaboration between University of Khartoum, Sudan and Karolinska Institutet, Sweden.

Informed consent (Case number:...)

We would like to ask whether we may include you in research about different causes of infertility, mainly whether female circumcision is related to infertility. The study will compare women who are under investigation for infertility with pregnant women. The aim is to identify risk factors for infertility so that these can be prevented in the future. If you participate we will keep everything confidential, and we will never reveal your name. Participation is fully optional, and you will receive the same standard of care independent of your choice.

What will it mean to participate:

We will perform the same investigations as would have been done otherwise. We will take blood samples and offer you to undergo laparoscopy, a surgical procedure where we will look at your internal genitals too see whether we can find any cause for the infertility problem. The blood samples will be stored for possible future use. If you participate, you will get the investigations for free. If we find any infectious disease you will get antibiotics for free. If we diagnose the cause of your infertility problem, we will NOT cover the treatment of this. That is, you will have to pay for any treatment of infertility yourself. We will pay only for the diagnostic procedures.

The study will not lead to any increased risk for you, since we do not perform anything extra just because of the study. However, there is always a risk to undergo surgery, for instance the risks of bleeding and infection.

Again, we would like to stress that participation is voluntary, and you will receive the same standard of care independent of your choice.

Would you like to participate?

Patient gave oral informed consent:

Date:

signed by Dr:

If you have any questions you can contact Dr Abdel Rahim Obeid phone 0123 58144 or Dr Susan El Musharaf phone 0123 54244

Informed consent for paper I

Controls

PRIMARY INFERTILITY IN SUDAN

A research collaboration between University of Khartoum, Sudan and Karolinska Institutet, Sweden.

Informed consent (**control** number:...)

We would like to ask whether we may include you in research about different causes of infertility, mainly whether female circumcision is related to infertility. The study will compare women who are under investigation for infertility with pregnant women like you. The aim is to identify risk factors for infertility so that these can be prevented in the future.

If you participate we will keep everything confidential, and we will never reveal your name. Participation is fully optional, and you will receive the same standard of care independent of your choice.

What will it mean to participate:

In addition to the routine blood samples taken in antenatal care, we will, at the same time, take some more blood. The blood samples will be stored for possible future use. If you participate, you will get all investigations for free, even the routine tests. If the tests reveal any infectious disease you will get antibiotics for free. The study will not lead to any increased risk for you.

Again, we would like to stress that participation is voluntary, and you will receive the same standard of care independent of your choice.

Would you like to participate?

Patient gave oral informed consent:

Date:

signed by Dr:

If you have any questions you can contact Dr Abdel Rahim Obeid phone 0123 58144 or Dr Susan El Musharaf phone 0123 54244

Informed consent for paper III

Impact of FGM on the girl child

A research collaboration between University of Khartoum, Sudan and Karolinska Institutet, Sweden.

Informed consent (Case number:...)

We would like to ask whether we may include your daughter/this child in research about different causes of emergency admissions in paediatrics. The aim is to be able to improve health care for girls. One of the things we will look into is if female circumcision is a risk factor for disease. Participation is fully optional, and the child will receive the same standard of care independent of your choice.

What will it mean to participate:

You will notice no difference if you participate or not. What will be done, is only that we record things from the journal. We will not record the name together with the other things, so everything will be kept fully confidential. The child will get exactly the same examinations, investigations and treatment independent of if you participate or not. The study will not lead to any increased risk, since we do not perform anything extra just because of the study.

Again, we would like to stress that participation is voluntary, and the child will receive the same standard of care independent of your choice.

The doctor verifies that informed consent was given by filling out and signing the data collection form.

Informed consent for paper V

Impact of FGM on the girl child

A research collaboration between University of Khartoum, Sudan and Karolinska Institutet, Sweden.

Informed consent (Renal failure case)

We would like to ask whether we may include your daughter/this child in research about different causes of renal failure in girls. The overall aim is to be able to improve health care for girls. One of the things we will look into is if female circumcision is a risk factor for disease. Participation is fully optional, and the child will receive the same standard of care independent of your choice.

What will it mean to participate:

We will interview you for the history and examine the child as usual. History taking and examination will be more detailed than is normally the case. A full examination, including examining heart, lungs, abdomen and inspection of eyes, mouth and genitals will take place. Otherwise, you will notice no difference if you participate or not. We will record things from the journal, but we will not record the name together with the other things, so everything will be kept fully confidential. The child will be offered exactly the same investigations and recommended the same treatment as normally at this hospital, even if you choose not to participate.

The study will not lead to any increased risk for the child.

Again, we would like to stress that participation is voluntary.

The doctor verifies that informed consent was given by filling out and signing the data collection form.