FEMALE EDUCATION AND FACTORS AFFECTING FERTILITY IN SUB-SAHARAN AFRICA

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1. Introduction

During the late 1970s and 1980s, the course of fertility, contraceptive use and various other intermediate fertility variables (breastfeeding, postpartum amenorrhoea, postpartum abstinence, proportions of women single) have been monitored by surveys belonging to the series of the World Fertility Survey (WFS), the Contraceptive Prevalence Surveys (CPS) and the Demographic and Health Survey (DHS). In addition, a number of countries engaged independently in national or regional surveys that yielded data comparable to those gathered in the WFS. In this paper, we shall take a closer look at the determinants of contraceptive use in sub-Saharan countries using primarily the data from the WFS and DHS rounds. The WFS describes the situation during the period 1978-82 and the DHS covers the years 1986-89.

A few countries participated in both rounds of surveys: Senegal, Ghana, Northern Sudan and Kenya. For the Ivory Coast, Benin, Nigeria, Cameroon and Lesotho, data are available from the WFS only. The DHS covered Mali, Liberia, Togo, Uganda, Burundi, Zimbabwe and Botswana as additional countries. Also the state of Ondo in Nigeria participated in the DHS.

The present analysis is performed at the level of *regions* within these sub-Saharan nations. A list and a map of the regions is given in the appendix, together with the weighted and unweighted sample sizes. Most surveys interviewed all women aged between 15 and 49 years, and the data used in the subsequent analyses pertain to characteristics of these women. Two countries provided data for ever-married women only: Northern Sudan and Lesotho. They had, however, a complementary household survey as part of the WFS, so that additional information is available (e.g. proportions of single women).

The choice in favour of a regional analysis rather than an individual-level one is mainly inspired by the fact that the latter type is being performed by other authors. In addition, several of the questions addressed here are posed at the macro-level. For instance, we wish to investigate the impact of the historical penetrations of the major religions into Africa upon the current changes in contraceptive use and selected other intermediate fertility variables. Much of this impact operates via the regional differences in female education and the policies persued with respect to female schooling. Not only have several countries in the study been influenced by more than one religion coming from outside (Christianity, Islam), but most also contain ethnic groups with regional clustering of patterns of social organization. Finally, also levels of socioeconomic development and accessibility may widely differ between regions within a country. All these *contextual* factors are shown to have had a marked impact on the patterns of reproduction (e.g. Lesthaeghe, 1989).

The overall outcome with respect to the study design is that we shall analyse demographic, cultural and socioeconomic indicators for 37 regions in the WFS-data set, 55 regions in the DHS-set, and 92 regions in the pooled set. Before addressing the results in greater detail, several theoretical points and findings from earlier research need to be considered first.

2. The two-phase transition and the role of female education

Any understanding of the changes in the sub-Saharan reproductive systems hinges on the following points:

i) Fertility is not solely determined by the degree of contraceptive-use effectiveness, but also by other important factors. We are referring here to the "intermediate" or "proximate" fertility variables such as fecundity, lactational amenorrhoea or postpartum abstinence (cf. Bongaarts, 1978). These variables are closely related to cultural patterns and forms of social organization (cf. Davis and Blake, 1956). This holds particularly in Africa (e.g. Caldwell, 1976; Page and Lesthaeghe, 1981) where regional differences with respect to these proximate determinants are very large.

ii) The notion of a two-phase transition has been entertained by several authors writing about fertility transitions in general (e.g. Easterlin, 1983; Kocher, 1973). They envisaged the possibility of an initial fertility *rise* occurring prior to a fertility decline. This initial rise is an integral part of the transition process as it stems from socioeconomic development factors affecting the levels of natural fertility and the supply of children. A decline in subfecundity or secondary sterility resulted from improved health care (Romaniuk, 1968; Retel-Laurentin, 1974; Frank, 1983; Larsen, 1989), and the shortening of durations of breastfeeding and of postpartum abstinence are often strongly associated with increased female education and urbanization (cf. Olusanya, 1969; Caldwell & Caldwell, 1977; Romaniuk, 1980; Nag, 1980; Adegbola et al, 1981; Gaisie, 1981; Mosley et al., 1982; Lesthaeghe et al., 1983).

iii) The initial increase in the supply of children is further enhanced by increased infant and child survival. Confronted with declining demand for children, the second phase of the transition is set in motion. This phase is characterized by declining desired family sizes, increased knowledge of contraception and subsequently increased use-effectiveness of fertility regulation. A reduced demand for children, as a response to diminished child utility, increased costs of child-rearing, or higher aspirations with respect to child quality, is often associated with the same factors of socioeconomic development that produced the initial fertility rise.

The intricate link between female education and the features of the two-phase transition showed up in S. Cochrane's (1979, 1983) analysis of cross-sectional data gathered at the individual level in a variety of countries. Cochrane reports the common existence of an inversely U-shaped link between fertility and education of respondents, with peak fertility frequently being located at lower primary education (Cochrane, 1983: 587-588). In another set of studies, Cochrane found a monotonically increasing level of marital fertility being associated with increased female education. In less than half of the studies reviewed by Cochrane the classic negative relationship emerged. The latter studies came predominantly from Latin America and not from Africa or Asia. The same author also reported that the cross-sectional effect of education on fertility is more negative at later than at earlier points in time, and more likely to be found in countries that have higher levels of urbanization, per capita income and daily caloric intake (1983: 613). In short, monotonically increasing fertility with education or inverted U-shaped relations were typical for areas in which female education acted more strongly in favour of increased natural fertility and reduced child-spacing than in favour of enhanced contraception.

These conclusions were largely borne out for sub-Saharan Africa in the contextual analysis of female education performed by Lesthaeghe et al. (1989) for the regions covered by the WFS. Through the calculation of the Bongaarts' indices, these authors attempted to measure the effects of lactational amenorrhoea and postpartum abstinence (combined into the overall non-susceptible period, or nsp for short) and the effect of contraceptive use-effectiveness. These indices were calculated for different educational groups within the various age groups for each of the 33 WFS regions (Nigeria excluded). Overall child-spacing was taken to decline by education in these cross-sections if the better educated women (5 or more years of schooling) could not adequately offset the effect of reduced overall postpartum non-susceptibility by increased contraception and would therefore, *other things being equal*, have higher marital fertility than illiterate women. The same contrast was equally inspected for women with just a few years of schooling (1-4 years) compared to illiterate women.

The conclusions of this study pertain predominantly to the late 1970s and capture most sub-Saharan regions during the first phase of the transition. It is worthwile summarizing the conclusions here again (Lesthaeghe et al., 1989: 164-165):

> "The effects of *individual* female education, measured for the youngest and the middle age groups (i.e. 15-24 and 25-34), is largely determined by the regional levels of development (i.e. an index that largely captured the aggregate level of female schooling). The other contextual variables have additional effects in such a way that:
>
> - overall child-spacing *declines most* with increased individual schooling in regions that have low development scores, high proportions Muslim or traditional religions, and a weaker tradition of female economic self-reliance;

- overall child-spacing *declines less* with increased individual schooling in areas that have higher development scores, higher proportions Christian and, furthermore, a tradition of greater female economic independence. In such areas, the education gap with respect to overall child-spacing is gradually being closed via increased use of contraception by the better educated women;
- overall child-spacing *improves* with individual education in a few areas only; they are characterized by the highest overall levels of female education, but are not necessarily urban".

Hence, the WFS-data revealed for the late 1970s that female education operated both as an individual and as a contextual variable, and that the balance between traditional child-spacing via lactational amenorrhoea and postpartum abstinence on the one hand and contraception on the other was conducive toward a positive fertility-education relationship in areas with the lowest scores for female education. The underlying scenario could be as follows (Lesthaeghe et al., 1989: 164-165):

> "At the onset, educated women are a select few and they start off with much less child-spacing than illiterate women, who still benefit from the traditionally long postpartum non-susceptible period. As more women are educated, thereby increasing the contextual level of education, illiterate women also reduce lactation and abstinence, and a fertility increase emerges in the area. During the third stage, however, when contextual levels of education have reached an average of 4 to 6 years (that is, when the majority of women have had some primary schooling), contraceptive use rises, the better educated women fully correct for lowered postpartum non-susceptibility, a positive spacing - education differential emerges, and fertility may start its decline. The pace of this scenario is, however, strongly influenced by cultural and organizational settings".

These findings for the late 1970s are in line with the general argument advanced by J.C. Caldwell (1980) that mass education, *especially when it incorporates women*, is capable of triggering off fertility transitions in developing countries. The effects, as indicated by the WFS-data, would start to emerge once most women have enjoyed partial or full primary education and when illiteracy among them has been considerably reduced. The "mass education-effect", however, affects *all* components of the reproductive system, including those that initially produce an increase in the potential supply of children. Similarly, mass education is an equally forceful agent in the reduction of infant- and childhood mortality, and may therefore account for much of the statistical relations found between the pace of the early-life mortality reduction and declining fertility.

As a consequence of these earlier theoretical and empirical insights, we shall test the relationship between female education and the various components of the reproductive system on the basis of the more recent DHS-regional data. The inclusion of the DHS-regions has the additional advantage of geographically broadening the spectrum of populations by expanding the data to more East-African and Southern African countries, and by reducing the possible West-African bias inherent to the WFS data set.

3. Female education and regional patterns of nuptiality

The first proximate determinant of overall fertility to be considered is the proportion of women in sexual unions. Both the WFS and the DHS surveys use a broader definition of marriage and include women reported as "having a partner" as being in a regular sexual union. Occasional premarital sexual relations are not taken into account by the definition. Judging from the ethnographic literature, the traditions with respect to the degree of tolerance of premarital sex varied considerably according to ethnic group and local custom. The norms ranged from a strong accentuation of premarital chastity to premarital sex and pregnancy being acceptable and occasionally desirable. More recently, however, there has been a growing concern, mainly in the urban areas, that the incidence of teenage pregnancy is rising, and that this entails negative effects for the individuals' schooling and further chances in life. In this paper we shall leave this issue on the side, and concentrate on entry into a first regular sexual union or marriage.

The ages at entry into a regular sexual union vary widely across sub-Saharan African regions. The proportions of single women aged 15-19 range from 10 to over 90 percent. The corresponding singulate mean ages at marriage (SMAM) vary from about 16 to over 21 years.

The main determinants of ages at entry into a sexual union are also well known (cf. Goldman and Pebley, 1989; Lesthaeghe, Kaufmann and Meekers, 1989). Firstly, there are a number of older, more traditional determinants that are intimately linked to patterns of social organization. The incidence of polygyny is often singled out as the prime factor leading to early marriage for women. This is obviously due to the fact that polygyny presupposes a large age difference between the spouses, and hence the combination of late marriage for men and early marriage for women. However, the female mean age at marriage can still vary considerably in polygynous societies, provided that a higher age at entry into a union on the female side is being matched by a corresponding increment on the male side.

The relationship between the incidence of polygyny and the age pattern of entry into a sexual union for women is shown in Figure 1 for the regions covered by the WFS and DHS-surveys. The indicator of polygyny used here is the percentage of currently married women aged 15-19 years reporting that they are living in a polygynous union. The nuptiality indicator is the proportion of women aged 15-19 still single. The scattergram in Figure 1 shows that a low incidence of polygyny corresponds with high proportions of young women still single and later marriage. But, the scatter of proportions single women widens considerably at higher proportions in polygyny. Hence, highly polygynous societies can exhibit *both* early and fairly late marriage for women, provided that the large age-gap between the spouses is maintained.

The second determinant of early marriage for women has been the Islamic influence on social organization. As argued by Goody (1973, 1976) and statistically tested by Lesthaeghe, Kaufmann and Meekers (1989), an early and more profound Islamization is associated with the emergence of a caste organization, a preference for cousin-marriage (endogamy), and a tighter social control on women via early first marriage or fast remarriage following divorce or widowhood. The impact of this factor is shown in Figure 2. This figure repeats the information contained in Figure 1, but also identifies the regions with more than 75 percent of women belonging to the Islamic faith. Of the 17 Islamic regions thus identified, 13 are located below the regression line and only 4 above it. The Sahelian Islamic societies contribute furthermore quite heavily to the set of regions that have both a high incidence of polygyny and very low proportions single in the age group 15-19. All of this confirms earlier findings from censuses and other sources.

A third traditional factor involved is matrilineal kinship organization. This factor is generally associated with later marriage for women, largely because matrilineal societies have less polygyny than neighbouring patrilineal or bilateral ones (cf. Lesthaeghe, Kaufmann, Meekers and Surkyn, 1988). The impact of this factor cannot be tested adequately with the present data set: the main string of matrilineal societies, running eastward from Angola to Northern Mozambique, is not sampled by either the WFS or the DHS-surveys. The only information available here pertains to the matrilineal Akan group in Ghana and the Ivory Coast. For the latter country, this information is lost in the present data file as a result of the regional classification not corresponding to the ethnic one.

Two additional factors have altered the traditional picture: female schooling and urbanization. Both tend to increase the proportions of single women in the age group 15-19, either directly or through a negative impact on polygyny.

The relationship between the percentage of women 15-19 still single and the mean number of years of schooling completed by women 15-49 in the region is given in Figure 3. This scattergram shows that the vast majority of regions with average schooling durations of 4 years or better (or, with fewer than 50 percent illiterate women) have proportions single women 15-19 in excess of 60 percent. This percentage corresponds approximately to a singulate mean age at marriage (SMAM) of 19 years (see Lesthaeghe, Kaufmann and Meekers, 1989: 249 for a statistical link between proportions single 15-19 and SMAM). At lower levels of education, however, the scatter is considerably wider. This is indicative of the existence of confounding factors.

These confounding factors have already been identified: polygyny, Islamization, and the survival of traditional religions and syncretic churches. To document this, we have reproduced the data from Figure 3 for regions with a low and a high incidence of polygyny respectively. The cutting point used here is a frequency of one third of currently married women 15-49 in a polygynous union. As can be seen from Figure 4 (low polygyny regions), there is no longer a positive relationship between female schooling levels in the regions and proportions single women in the age group 15-19. The overall positive relationship as displayed in Figure 3 stems *entirely* from the positive relationship witnessed *solely* among the highly polyggynous societies, as shown in Figure 5.

A similar, although less pronounced feature emerges when the distinction is made between regions that have more than 50 percent Christian versus those with more than 50 percent in Islam or traditional religions. Among the Christian regions, there is again no positive relationship between regional female schooling levels and proportions of young women still single (cf. Figure 6). The positive relationship emerges only for regions that are either Islamic or have high proportions in traditional and syncretic religions (see Figure 7).

From these analyses emerges that Islamization, traditional religions and especially polygyny (i.e. three factors that conditioned traditional social organization) are major confounding variables that are still of considerable importance in the study of nuptiality. They shape the positive relationship between female schooling levels and ages at first union entry at the aggregate level.

Before closing this section, it should be stressed that *individual* ages at marriage *within* regions are highly likely to be positively related to *individual* durations of schooling. This was for instance clearly displayed in the individual-level analyses of the WFS-surveys, and the positive relationship at the individual level is a recurrent finding in most studies of nuptiality. The present aggregate-level exploration only indicates:

1) that the combination of three confounding factors of a historical and contextual nature (i.e. polygyny, Islamization, survival of traditional religions) still has a major effect by locking a set of female populations into the "low literacy - early marriage" syndrome,

2) and that, *leaving such areas aside*, the aggregate level of female education is a poor predictor of regional ages at first marriage for women in the areas sampled by the WFS and DHS. This points in the direction of another set of possible causes of differentiation, mainly operating in those Christianized

societies that have lower polygyny levels (i.e. predominantly in East- and Southern Africa).

4. Female education and factors of traditional child-spacing

As indicated earlier, female education has been one of the prime factors involved in the shortening of birth intervals in sub-Saharan Africa during at least the last three decades. We are refering here to the negative impact of female education on the durations of breastfeeding, postpartum amenorrhoea and postpartum abstinence. As such, increased schooling levels for women have been partially responsible for the initial fertility increase during the first phase of the transition.

The negative relationship between female education and the durations of each of the three postpartum variables has been amply documented by the WFS-surveys and many other sources. This holds particularly for *individual-level* studies conducted within specific regions or countries (e.g. Olusanya, 1971; Caldwell and Caldwell, 1977; Page and Lesthaeghe, 1981; Locoh, 1984; Mosley et al., 1982; Gaisie, 1984; Mpiti and Kalule-Sabiti, 1985; Tambashe, 1984).

At a regional level, similar negative relationships are found within the WFS and DHS-samples. This holds for all postpartum variables, as can be seen from the scattergrams presented in Figures 8, 9, 10 and 12. The measurement of the durations for each of these postpartum variables is based on the prevalence-incidence ratio (or stationarity mean) covering the birth stream of the last three years. The regional scatter in the relationship between female education and postpartum behaviour is, however, still considerable: the correlation coefficients based on polynomial fits vary between 0.22 and 0.65. Particularly the relationship with postpartum abstinence is weak (polynomial $r = 0.22$).

Durations of breast-feeding in the WFS and DHS-regions vary predominantly between 12 and 25 months. This means that the sub-Saharan populations covered here are still at the long duration end of the international spectrum. For example, regions with aggregate schooling levels of 5 or more years have an average duration of breastfeeding of about 17 months, with none dipping below one year (see Figure 8). This implies that the contribution of lactational amenorrhoea to the length of the overall period of postpartum non-susceptibility is still considerable. Figure 9 indicates that the length of lactational amenorrhoea in the regions varies between 8 and 20 months, and that the mean duration for the regions with the higher levels of schooling is still of the order of 11 months. Moreover, the greater drop in average durations of amenorrhoea displayed by this regional cross-section occurs at the lower levels of schooling, i.e. below the average of 2 years of education. The curvilinear shape of the relationship in Figures 8 and especially 9 is in accordance with the two-phase transition thesis: the reductions in breast-feeding and lactational amenorrhoea occur in regions at early stages of development and at the beginning of female schooling. But the same curve could also be interpreted in another way. Focussing on the populations that are at the high end of the educational spectrum, the flattening of the curve could be taken to mean that there could be a lower threshold below which further female schooling would no longer produce any further significant declines in the duration of the postpartum variables.

Conclusions from regional cross-sections can be quite hazardous. The inspection of the trend is a much safer way of detecting a slowing down of the decline in the traditional props of sub-Saharan child-spacing. The data on the four postpartum variables and their evolution during the 1980s are available for the countries that participated in both the WFS and DHS-surveys. The results are presented in Table 1. The overall outcome of the comparison is that in the overwhelming majority of the regions of Kenya, Ghana, Senegal and Northern Sudan *no further erosion of the traditional forms of child-spacing* has occurred. Allowing for the fact that the measurements of these variables are of an approximate nature and that sampling fluctuations play a role, the results in Table 1 show that, on the whole, there has been a limited decrease in the duration of breastfeeding in the areas with very low schooling levels of women (e.g. in Senegal and Northern Ghana), but that there are few instances of a decline in the regions with higher schooling levels. Also the durations of postpartum abstinence show no systematic trend indicative of further declines during the last decade in the regions surveyed in Table 1. The conclusion so far is then, that the fragmentary evidence for a small subset of regions supports the thesis that the traditional mechanisms of child-spacing may have remained fairly intact at the durations observed during the late 1970s. If this holds, gains in contraceptive use-effectiveness would have become the prime source of marital fertility change during the 1980s. It is, however, still necessary to stress the conditional nature of this statement since the presumed absence of a further downward trend in the postpartum variables needs documenting for many other regions as well.

Before concluding, the lack of a strong cross-sectional relationship between regional levels of female education and the durations of postpartum abstinence needs to be addressed. The amount of scatter displayed in Figure 10 is considerable. This was to be expected: the earlier analysis by Lesthaeghe and Eelens (1989: 99-103) with WFS-data for 61 ethnic groups showed that the duration of postpartum abstinence was far more related to cultural and organisational traits of sub-Saharan societies than to their levels of female schooling and degrees of economic development. The presence of durations of postpartum abstinence in excess of one year was almost entirely confined to the West-African populations in the WFS that scored high on traditional religion, polygyny, autonomous female activity in trade *and* were, at the same time, weakly influenced by the structural features associated with more profound Islamization (e.g. preference for endogamous marriage or social caste development). It was also clear from the ethnographic literature (cf. Schoenmaeckers et al., 1981) that the more profoundly Islamized societies of the Sahel were gradually adopting the rule of 40 days abstinence only. From this, we should expect that the length of postpartum abstinence is more strongly influenced by the incidence of polygyny (positive relationship) and by the stength of Islam (negative relationship). This proposition is put to the test in Figure 11. The positive link with polygyny is clearly in evidence (polynomial r = 0.55 against 0.22 with female schooling), and moreover, the overwhelming majority of Islamic regions contribute to the instances with short durations of postpartum abstinence (less than 8 months).

The outcome variable that directly matters for fertility is the length of the overall postpartum period of non-susceptibility (nsp). It is defined for each individual as the longest of either the duration of lactational amenorrhoea or the length of postpartum abstinence. The "abstinence bonus", or the difference between the mean length of the overall nsp and the mean duration of lactational amenorrhoea (Lesthaeghe, 1989: 134-137) is about 3 months when the average duration of postpartum abstinence equals that of lactational amenorrhoea. However, the abstinence bonus rises rapidly if the mean of abstinence becomes larger than the mean of amenorrhoea. Abstinence bonuses of the order of 5 to 10 months were common in the WFS-regions of the Ivory Coast, Benin, Ghana, Nigeria and Cameroon. In the DHS-regions, abstinence bonuses of 4 to 10 months are found in Liberia, Togo and Ondo State (Nigeria).

The main conclusions with respect to the postpartum variables are as follows:

1) the sub-Saharan durations of breastfeeding and lactational amenorrhoea are still at the high end of the international spectrum of LDC's in general, even in regions with the highest levels of female education;

2) the DHS-surveys equally locate the areas with the long postpartum abstinence durations in the West African zone identified by earlier ethnographic descriptions and surveys;

3) postpartum abstinence is much less determined by regional levels of female schooling than durations of breastfeeding and lactational amenorrhoea, but much more by traditional features of social organization;

4) postpartum abstinence still contributes an important extra period of postpartum non-susceptibility in West-African regions;

5) the regions covered by both the WFS and DHS display no further systemactic decline in the postpartum variables during the 1980s. At least for these regions, gains in contraceptive use-effectiveness should have had their full impact on the reduction of fertility within sexual unions.

5. Female education and contraception

In this section we shall consider the relationship between female education and desired family size, knowledge of modern methods of contraception, and actual contraceptive use. This will be done with the following regional indicators:

- the percentage of women currently in a union who want no more than 4 children;

- the percentage of all women who know at least one modern method of contraception (i.e. pill, injectables, IUD, barrier methods, spermicides);

- the percentage of women currently in a union who are also current users of a modern method.

Figure 13 depicts the relationship between the average length of schooling in the WFS and DHS-regions and the percentage of married women with desired family sizes not exceeding 4 children. The expected positive relationship emerges (polynomial r = 0.73). The percentage opting for such smaller family sizes commonly rises above 30 for regions with schooling averages of 4 years or more better, and above 50 for several regions in Kenya and in urban centres of Botswana and Zimbabwe. By contrast, the level of 30 percent opting for family sizes of at most 4 children is exceeded only in about one fifth of the regions with average schooling durations below 4 years. Such areas are furthermore often national capitals: Khartoum, Lomé, Cotonou, Bamako. This is obviously indicative of an extra urban effect.

It should also be noted that areas with fewer than 10 percent of women opting for family sizes of 4 children or less were and are still predominantly concentrated in West Africa. The WFS showed that such low percentages were observed in most of the Ivory Coast, Nigeria and Cameroon. In Ghana and Benin, such low percentages were found in the northern regions. Also the WFS-data for Senegal show percentages around 10 for regions other than Dakar and Thies. The DHS-data confirm the persistance of these low percentages of women with smaller desired family size in West Africa. The 15-percent level is not exceeded in Northern and Upper Ghana, the Sinoe and Grand Gedeh regions of Liberia, the Mopti, Gao and Tombouctou, Kayes and Koulikoro regions of Mali, in most of Senegal, in Ondo State (Nigeria), and in the Savannah region of Togo. The only regions outside West Africa with such low percentages are the Kordofan and Darfur provinces of Sudan.

Also the knowledge of modern methods of contraception is strongly related to average female schooling levels, as shown in Figure 14 (polynomial r = 0.77). Below the educational average of 4 years, knowledge of at least one modern method varies widely from virtually non-existent to almost 90 percent. Above this educational average of 4 years of schooling, almost all regions exhibit knowledge levels of 50 percent or better. The scatter in Figure 14 is equally related to urbanity (positive effect) and Islamization or resistence of traditional religions (negative effect).

The next figure displays the relationship between the use of modern methods and the knowledge level (Figure 15). The relationship is strong (polynomial r = 0.80), *but its pattern deviates markedly from linearity*. Use of modern methods stays below 10 percent among women currently in a union for as long as the regional knowledge level remains below 80 percent. Only at the very high levels of knowledge about modern contraception is there a sharp increase in the usage of such methods.

As indicated in Figure 14, knowledge levels of 90 percent or better only emerge in regions with female schooling averages of 4 years or more. As a consequence, one should expect levels of current use of modern contraception in excess of 15 percent to emerge only in regions with *both high knowledge levels* (80 percent or more) *and high female educational* levels (above schooling averages of 4 years).

This expectation is borne out in Figure 16 which shows the link between the percentage of users of modern methods and the regional female schooling averages. Usage levels above 10 percent are virtually never reached in regions with mean female education durations below 4 years. Beyond this schooling level, the scatter widens considerably and the average percentage of users rises much more rapidly.

A first glimpse of the contraceptive usage rise for the regions with better female education could already be gleaned from the WFS-data for the late 1970s and early 1980s (see black dots in Figure 16). The additional information gathered by the DHS in the late 1980s (white dots) illustrates the more general nature of the emerging relationship.

It should, however, be stressed that the regions that score highly on both modern method use and female education stem largely from Zimbabwe and Botswana (see Figure 17, black dots). Conversely, Islamic regions contribute disproportionately to the set of areas characterized by the combination of low female schooling and low modern method usage (see Figure 18, black dots).

The evolution in desired family size and contraceptive knowledge and use can again be traced for the 1980s in countries that participated in both the WFS and DHS. The results are presented in Table 2. In Kenya, knowledge levels were already very high in 1978 (above 80 percent) and this results, in combination with a rapid rise of the percentage of women not wanting to exceed the 4-child family, in substantial increases in the percentage of users of modern methods. Knowledge levels in Ghana in 1980 were regionally much more heterogeneous than in Kenya, and the increase in proportions with smaller desired family sizes during the 1980s is more modest as well. From this, one could still expect a significant but smaller increase in usage of modern contraception. However, no such evolution occurred. Instead, a *decline* in contraceptive use cannot be ruled out. Hence, these two countries, that started with relatively high educational levels for women after their independence, have continued to follow *diverging* paths with respect to family planning success.

Senegal and Northern Sudan are typical cases for the Sahelian Islamic societies with lower levels of female education. In both countries there has been a noticeable increase during the 1980s of the knowledge of modern methods of contraception. Several areas, other than the capitals, now reach knowledge levels between 70 and 80 percent. However, the proportion of women with smaller desired family sizes has hardly changed and the increase of contraceptive use is insignificant. In the regions of Northern Sudan, a decline in current use of modern methods could have occurred as well.

The main conclusions from this section are:

1) there is a strong relationship between the regional levels of female schooling and respectively the proportion of women with reduced desired family size, the knowledge of modern contraception, and its actual use by women currently in a sexual union;

2) current use of modern methods only increases above the 10 percent level in regions that have a mean length of female schooling of 4 years or more and less than 50 percent of women still illiterate;

3) these conditions were met in Zimbabwe and Botswana, and also in several regions of Kenya. In these areas, there has been a

corresponding rise in actual contraceptive use. However, there are several areas in other countries that meet this educational condition (e.g. Imbo province in Burundi, all regions in Ghana except the two northern ones, Montserrado in Liberia, Ondo State, Khartoum and Kampala) where current use has remained low or where it could have decreased (Ghana, Sudan). This wide divergence within the set of areas with adequate female schooling levels suggests that family planning programme effort and resources committed to such programmes could have been a decisive factor.

6. A multivariate summary of the regional analyses

The bivariate relationships considered in the previous sections are now being reconsidered within the framework of two multivariate models. Firstly, we shall present a set of multiple regressions applied to the DHS-data alone and to the pooled WFS and DHS-data subsequently. Thereafter, a LISREL-model will be tested, again for these two data sets.

The regression models are presented in Figures 19 (DHS only) and 20 (WFS + DHS). In these models we have considered four independent variables:

- the proportions of respondents being Muslim;
- the average length of schooling for women 15-49;
- the presence of a large and dominant urban area in a region (dummy variable);
- the percentage of married women 15-49 being in a polygynous union.

The links between these four background variables are discussed first.

Islamization and urbanity are considered to have important but obviously opposite effects on the level of female education. This is borne out in both the DHS and in the pooled regional samples. The effect of proportions Muslim, measured by standardized regression (beta) coefficients, is respectively -0.49 and -0.51. By contrast, the effect of urbanity is +0.47 and +0.41. The percentage of married women in polygyny is made dependent on Islamization, urbanity and female education. In both data sets, only the negative effect of female education is significant and large: beta-coefficients are -0.50

and -0.62 respectively. Other factors, not specified in the model but subsumed in the residual variable U2, exert a major influence on the incidence of polygyny (effects of U2 are 0.86 and 0.87). This is concordant with the knowledge that high polygyny levels are predominantly a West-African feature, and that polygyny is associated positively with other forms of resistence of typical features of sub-Saharan culture and social organization (e.g. resistence of traditional religions, high involvement of women in trade, survival of female secret societies or of institutionally structured economic and political networks for women). Also the negative association between polygyny and matrilineal systems of descent should be quoted as another example of a historical connection which is not explicitly considered in the model. The polygyny variable can therefore be considered as proxy for a broader spectrum of features of social organization that is particularly relevant for the West-African regions in our samples.

During a second step, we have made *each* of the demographic variables dependent on the four background variables. In the regressions based on both the WFS and DHS-regions, also a time variable (years since 1978) has been introduced to allow for heterogeneity with respect to year of measurement. It should also be noted that the regions of Senegal, Kenya, Northern Sudan and Ghana contribute two data points in the pooled WFS + DHS sample. These measurements are approximately 10 years apart.

In both samples, the effect of female schooling levels is strongly dominant for the mean lengths of breastfeeding, postpartum amenorrhoea and overall postpartum non-susceptibility. The same holds for lowered desired family size, knowledge of contraception and actual usage. Especially for the latter dependent variables adjusted values of R^2 exceed 0.60. This implies that Islamization and urbanity have either no or only modest direct effects on these variables and that their indirect effect is almost exclusively channeled through female schooling levels.

This structure does *not* apply to the remaining two dependent variables: proportions single in the age group 15-19 and postpartum abstinence. Instead, ages at marriage for women in the regions is much more strongly influenced by their levels of polygyny and by Islamization (cf. supra). Also regions with long durations of postpartum abstinence are predominantly those with the higher incidence of polygyny and with the other typically West-African features of social organization.

Finally, the striking similarity of the regression results of the DHS-regional sample and of the pooled WFS + DHS sample indicates that the present findings are quite robust for as long as one considers regions in West, East and Southern Africa. However, there are no observations for Central Africa, and for regions that were strongly affected by high levels of infecundity (e.g. Gabon, southern Sudan, North-West Zaire, the Central African Republic).

In the two LISREL-models that follow (Figure 21 for the DHS-regions and Figure 22 for the DHS + WFS sample), we have also assumed a causal linkage between the demographic variables themselves. The length of the postpartum non-susceptible period is placed first in the causal chain, followed by lowered desired family size and knowledge of modern contraception. The actual contraceptive use is placed at the end of the causal scheme.

We have also taken advantage of the LISREL-feature that allows for the construction of complex variables on the basis of highly correlated indicators. The level of female education is now measured as the common component of the average female schooling durations and the percentage of illiterate women aged 15-49 in the regions. Similarly, the knowledge level of modern contraception and the indicator of preferences for reduced family size are put into a single variable. Finally, the percentage of users of modern contraception was complemented by a broader index of use-effectiveness in which less efficient methods (i.e. rythm, withdrawal, but *not* abstinence) are allowed to contribute (with an efficiency weight set at 0.60).

The two LISREL-models are characterized by an excellent goodness of fit (0.98), uncorrelated residuals, and a strong similarity between the respective sets of standardized coefficients. The paths with low coefficient are dropped from the figures for reasons of clarity. They can, in fact, safely be ignored.

In both regional samples, there is a strong line of influence from "Islam" and "urban" to female schooling and illiteracy, and then directly to contraceptive use. All other effects on contraceptive use are small or completely negligible. This illustrates again the central role of female education in the process of demographic change in sub-Saharan Africa.

The two LISREL-models not only show the key role of female education in the geographical patterning of the second phase of the fertility transition centered on the adoption of contraception, but equally the role of the same social variable on the patterning of the first phase centered on the reduction of traditional forms of child-spacing. Female schooling exerts a strong negative effect on the length of the postpartum non-susceptible period. The control for female education obliterates the direct negative effect of urbanity on nsp, but not that of Islamization. The latter variable maintains its negative direct effect on nsp, largely through the link between Islam and the reduction of the length of postpartum abstinence.

The only unanticipated feature in the two LISREL-models is that female schooling acts directly on current contraceptive use and not via the intermediate variables related to knowledge of modern contraception and reduced desired family size. The reason for this is that the LISREL-models are based on correlation coefficients that assume linear relationships. These coefficients are underestimated in the instances of strong non-linearity. An example of the latter is, as shown in Figure 15, the link between knowledge and actual use of modern methods. Given the strong link between female education and both lowered desired family size and contraceptive knowledge, in tandem with a stronger correlation between female schooling and contraceptive use than between knowledge or desired family size and use, it is the direct effect of female schooling on contraceptive use that will be inflated.

Finally, a set of effects is associated with polygyny, which is, as indicated earlier, a proxy for a wider cluster of typically West-African features of social organization. In both LISREL-models, polygyny is associated with longer durations of nsp via its positive contribution to the postpartum abstinence bonus, and, via the latter variable, negatively with both contraceptive knowledge and lower desired family size. Polygyny displays also a negative direct effect on contraceptive use, which essentially means that the more traditional West African regions have a slower development of the second phase of the fertility transition than is to be expected on the basis of female education alone.

7. Female education and the fertility reducing effects of postpartum non-susceptibility and contraception

In this section we shall consider the effect of female education on the following two characteristics of the WFS + DHS regions:

1. the *joint* fertility reducing effects of both postpartum non-susceptibility and contraception;
2. the degree to which the fertility reducing effect of contraception takes over from that of postpartum non-susceptibility.

In order to do this, the mean length of the nsp and the contraceptive use-effectiveness index are converted to the Bongaarts' indices of non-susceptibility (C_i) and of contraception (C_c) (see Bongaarts and Potter, 1983). The index C_i is defined as:

$$C_i = 20/(18.5 + \text{nsp}) \qquad [1]$$

If no breastfeeding and postpartum abstinence are practiced, the birth interval equals about 18.5 months for waiting time to conception, time lost due to foetal loss, and gestation, plus 1.5 months for minimal postpartum amenorrhoea. The index C_i is a simple ratio between such a minimal birth interval of 20 months and an interval prolonged by the observed period of postpartum non-susceptibility.

The index of contraception is obtained as:

$$C_c = 1 - (1.08 * u * e) \qquad [2]$$

where u is the proportion of users among women 15-49 in a sexual union and e the method-specific effectiveness. In our computations e is set at 0.60 for the less efficient methods and at 0.97 for the more efficient ones. The coefficient 1.08 represents an adjustment for the fact that some couples do not use contraception if they know or believe that they are infecund.

The two indices, C_i and C_c, indicate respectively which fraction of the total fecundity rate (TF) remains after allowing for the fertility reducing effects of postpartum non-susceptibility and contraception. The outcome TN * C_i C_c represents the total marital fertility rate (TMFR). Hence

$$TMFR = TF * C_i * C_c \qquad [3]$$

or, after taking logs to achieve additivity:

$$\log TMFR = \log TF + \log C_i + \log C_c \qquad [4]$$

Since C_i and C_c are fractions, their logs take negative values. In the present application we shall ignore the value of TF and adopt a *ceteris paribus* clause with respect to the total fecundity rate in the regions. It should, however, be noted that levels of infecundity higher than normal have a major negative impact on TF. In the sample of regions used here, the Central African zone of high levels of infecundity is not represented.

The joint degree of fertility reduction stemming from postpartum non-susceptibility and contraception can be represented as C_iC_c or ($\log C_i + \log C_c$). Since we are adding two negative values in the latter expression, the degree of fertility reduction *increases* as the sum reaches lower negative values. The joint effect will be denoted as S:

$$S = 1000 (\log C_i + \log C_c) \qquad [5]$$

Alternatively, we also wish to determine to which extent the modern form of contraception is overtaking the traditional form operating via postpartum non-susceptibility. We therefore define the difference D as:

$$D = 1000 (\log C_i - \log C_c) \qquad [6]$$

As D approaches zero, contraception is catching up with the effect of traditional forms of child-spacing, and when D reaches positive values, the fertility reducing effect of contraception outweighs that of lactational amenorrhoea and postpartum abstinence.

The plot of S against D is presented in Figure 23 (polynomial r = 0.86). The curvilinear relationship clearly indicates that a relatively high degree of fertility reduction can be achieved via the exclusive action of lactational amenorrhoea and long periods of postpartum abstinence (regions on the left of the figure). When the latter periods are shortened without adequate compensation through contraception, the overall degree of fertility reduction obviously weakens (regions near the top of the curve). The second phase of the transition is observed in areas where modern contraception increases and produces again higher levels of overall fertility reduction (regions on the left of the figure). In the present sample of regions, there are only 9 cases in which the effect of contraception is greater than that of postpartum non-susceptibility (positive values of D). These regions are located in Zimbabwe (7), Botswana (1) and Kenya (1). However, a few urban areas are close to this point: Khartoum, Kampala, Nairobi. The same also holds for rural Botswana, the rest of Zimbabwe, and several other regions in Kenya.

The relationship between female education and respectively S and D is shown in Figures 24 and 25. The relationship with the overall degree of fertility reduction (S) is weakest (polynomial r = 0.54), obviously because high degrees of fertility reduction can be obtained via either the traditionally long period of non-susceptibility or modern contraception. The effect of female education on D is stronger since the two components react in opposite ways to female education. The fit for the scattergrams represented in Figure 25 bears this out (polynomial r = 0.77). However, it should be noted again that the scatter widens considerably for regions with average female schooling levels of 4 years or more. Especially West African regions with better schooling levels have lower degrees of compensation via modern contraception, whereas the East- and Southern African regions with similar schooling levels are reaching or crossing the break-even point (i.e. D = 0).

8. The uncertain future

The momentum of a rise in contraceptive use and the spreading of contraception to other regions depend on a number of conditions. Firstly, the demand for children must be declining as a consequence of diminished child utility and/or increased costs of children. Secondly, efficient forms of contraception must be available at affordable prices. This implies that investments in child-quality and availability of family planning services should continue to expand. According to Boserup (1985), rising aspirations with respect to child-quality and rising educational costs could trigger off a fertility decline. But it is equally obvious that the notion of a "crisis-led" transition assumes that *educational aspirations are sustained and that the educational system continues to function.*

If, by contrast, there is a contraction of job opportunities, a breakdown of the schooling system, and a growing scarcity of family planning supplies and services, other scenarios may well develop. During the last decade, many sub-Saharan countries have experienced declining foreign earnings, which, in tandem with the "structural adjustment" policies of the IMF and the World Bank, has led to *actual declines* in school enrolment figures. The motor of the demographic transition process, identified in this paper as being female education, not only sputters but has come to a complete standstill in many regions. If in addition, family planning supplies and services become scarce, the original notion of a "crisis-led" fertility transition can be abandonned. Instead, a much deeper crisis may be producing the return toward a plain subsistence economy. One should also note that we are not referring here to countries that have experienced internal warfare (Angola, Mozambique, Ethiopia, Somalia...) but to the vast majority of countries on the continent. In such circumstances, the increased adoption of more effective forms of fertility control can be ruled out.

To sum up, the fact that the fertility transition has started in a few better off sub-Saharan countries does not provide any guarantee whatsoever that many other countries will soon follow. The present deep crisis in so many of them has lasting effects on health and education, and this will seriously hamper the development of the second phase of their fertility transition.

9. Final conclusions

First of all, it should be stressed that the WFS and DHS-sample of regions is not representative for the whole of sub-Saharan Africa. As a consequence, the results of the present study should be interpreted with care.

The main points elucidated in the analyses can be summarized as follows:

1. In the vast majority of regions fertility reduction is still predominantly accomplished through prolonged periods of postpartum non-susceptibility. Only in a minority of regions belonging to three countries (Zimbabwe, Botswana, Kenya) is there a comparable effect stemming from contraceptive use.

2. In the countries for which there are comparable data over time, there are no traces of a further decline in the components of the non-susceptible period during the 1980s. Under such circumstances, rises in contraceptive use-effectiveness would carry their full effect.

3. West-African regions still benefit from a considerable postpartum abstinence bonus, but continue to score low on contraceptive knowledge, reduced desired family size and actual contraceptive use.

4. Female education is particularly strongly associated with reduced durations of postpartum non-susceptibility and increased use of contraception. These relationships are, however, curvilinear. Contraceptive use above 10 to 15 percent only emerge in regions with average female schooling durations of 4 years or better and fewer than 50 percent of women 15-49 still illiterate. Furthermore, the scatter widens considerably beyond this educational threshold. Among the areas with better levels of female education, there is a marked contrast with respect to contraceptive use between regions in Zimbabwe, Botswana and Kenya with high levels and the other regions in the sample with much lower levels of usage.

5. This contrast for the better educated areas suggests that family planning programme effort and availability of family planning facilities and supplies have had a considerable positive impact on use as well.

6. Islamic areas continue to be at a major disadvantage, predominantly because of their lower levels of female education.

7. The increase in contraceptive use can only be sustained if both female education and family planning programme effort progress. In many regions one witnessed an actual standstill or even a decline in both female school enrolments and availability of

family planning logistics. As the economic and political crises deepen to the point that entire regions are returning to a subsistence economy, one cannot rule out a major setback with respect to contraceptive use. In other words, the rapid rise in contraceptive use witnessed during the 1980s in three better off countries cannot be taken as a sign that the fertility transition is about to start in the other regions as well. Further regional monitoring of the development of each specific situation is hence an absolute necessity.

BIBLIOGRAPHY

Adegbola, O., H.J. Page, Lesthaeghe, R. (1981): "Child-spacing and fertility in Lagos", in H.J. Page and R. Lesthaeghe (eds): Child-spacing in tropical Africa - Traditions and change, Academic Press, London: 147-180.

Bongaarts, J. (1978): "A framework for analyzing the proximate determinants of fertility". Population and Development Review, 4: 105-132.

Boserup, E. (1985): "Economic and demographic interrelationships in sub-Saharan Africa", Population and Development Review (11) 3: 383-398.

Caldwell, J.C. (1976): The socio-economic explanation of high fertility, Australian National University, Canberra.

Caldwell, J.C. (1980): "Mass education as a determinant of the timingg of fertility decline", Population and Development Review 6: 225-255.

Caldwell, J.C. and Caldwell, P. (1977): "The role of marital sexual abstinence in determiningg fertility: a case study of the Yoruba in Nigeria", Population Studies (31) 2: 193-217.

Cantrelle, P., Leridon, H. (1976): Facteurs autres que la contraception affectant la fécondité, World Fertility Survey - International Statistical Institute, WFS/TECH 176, Voorburg.

Cochrane, S.H. (1979): Fertility and education: What do we really know? Johns Hopkins University Press, Baltimore.

Cochrane, S.H. (1983): "Effects of education and urbanization on fertility" in R.A. Bulatao and R.D. Lee (eds): Determinants of fertility in developing countries, Academic Press, New York, vol. 2: 587-625.

Davis, K. and Blake, J. (1956): "Social structure and fertility - An analytical framework", Economic Development and Cutural Change, 4: 211-235.

Easterlin, R.A. (1983): "Modernization and fertility - A critical essay" in R.A. Bulatao and R.D. Lee (eds): Determinants of fertility in developing countries, Academic Press, New York, vol. 2: 562-586.

Frank, O. (1983): "Infertility in sub-Saharan Africa, estimates and implications", Population and Development Review, 9: 137-145.

Gaisie, S. (1984): The proximate determinants of fertility in Ghana, International Statistical Institute, WFS Scientific Reports nr. 53, Voorburg.

Gaisie, S.K. (1981): "Child-spacing patterns and fertility differentials in Ghana" in H.J. Page and R. Lesthaeghe (eds): Child-spacing in tropical Africa - Traditions and Change, Academic Press, London: 237-253.

Goldman, N. and Pebley, A. (1989): "The demography of polygyny in sub-Saharan Africa", in R. Lesthaeghe (ed): Reproduction and social organization in sub-Saharan Africa, University of California Press, Berkeley: 212-237.

Gomes, M. (1984): "Family size and educational attainment in Kenya", Population and Development Review (10) 4: 647-660.

Goody, J. (1973): "Polygyny, economy and the role of women" in J. Goody (ed): The character of kinship, Cambridge University Press, Cammbridge UK.

Goody, J. (1976): Production and reproduction - A comparative study of the domestic domain, Cambridge University Press, Cambridge UK.

Hammerslough, C.R. (1991): "Women's groups and contraceptive use in rural Kenya", IUSSP-seminar on the course of the fertility transition in sub-Saharan Africa, Harare, 19-22 Nov.

Kocher, J.E. (1973): Rural development, income distribution and fertility decline. The Population Council, New York.

Larsen, U. (1989): "A comparative study of the levels and the differentials of sterility in Cameroon, Kenya and Sudan", in R. Lesthaeghe (ed): Reproduction and social organization in sub-Saharan Africa, University of California Press, Berkeley: 167-211.

Lesthaeghe, R. (1989): "Production and Reproduction in Sub-Saharan Africa - An overview of organizing principles", in R. Lesthaeghe (ed): Reproduction and social organization in Sub-saharan Africa, University of California Press, Berkeley: 13-59.

Lesthaeghe, R. and Eelens, F. (1989): The components of sub-Saharan reproductive regimes and their social and cultural determinants - Empirical evidence", in R. Lesthaeghe (ed): Reproduction and social organization in sub-Saharan Africa, The University of California Press, Berkeley: 60-121.

Lesthaeghe, R., Kaufmann, G., Meekers, D. and Surkyn, J. (1988): "Age at marriage, polygyny and postpartum abstinence - A macro-level analysis of sub-Saharan societies", Rockefeller Foundation workshop on "Status of women and fertility", Bellagio, June 6-10.

Lesthaeghe, R., Vanderhoeft, C., Becker, S. and Kibet, M. (1983): "Individual and contextual effects of female education on the Kenya marital fertility transition", IPD-Working Paper 83-9, Vrije Universiteit, Brussels.

Locoh, T. (1984): Fécondité et famille en Afrique de l'Ouest - Le Togo méridional contemporain, Cahier de l'INED, nr. 107, Presses Universitaires de France, Paris.

Lucas, D. (1991): "Mass education and fertility decline: implications for Southern Africa", IUSSP-seminar on the course of the fertility transition in sub-Saharan Africa, Harare, 19-22 Nov.

Makinwa-Adebusoye, P. (1991): "Changes in the costs and benefits of children to their parents - The changing costs of educating children", IUSSP-seminar on the course of the fertility transition in sub-Saharan Africa, Harare, 19-22 Nov.

Mosley, W.H., Werner, C.H. and Becker, S. (1982): "The dynamics of birth-spacing and marital fertility in Kenya", World Fertility Survey Scientific Reports, nr. 30, International Statistical Institute, Voorburg.

Mpiti, A.M., Kalule-Sabiti, I. (1985): The proximate determinants of fertility in Lesotho, International Statistical Institute, WFS-Scientific Reports, n½ 78, Voorburg.

Nag, M. (1980): "How modernization can also increase fertility", Current Anthropology 21: 27-36.

Njogu, W. (1991): "Contraceptive use in Kenya - Trends and determinants", Demography (28) 1: 83-99.

Njogu, W. and Martin, T.C. (1991): "Fertility decline in Kenya: the role of timing and spacing of births", IUSSP-seminar on the course of the fertility transition in sub-Saharan Africa, Harare, 19-22 Nov.

Olusanya, P.O. (1969): "Modernization and the level of fertility in western Nigeria", in Proceedings of the International Population Conference (London); IUSSP, Liege.

Olusanya, P.O. (1971): "Nigeria: cultural barriers to family planning among the Yorubas", Studies in Family Planning (37): 13-16.

Page, H.J. and Lesthaeghe, R. (1981): Child-spacing in tropical Africa - Traditions and change, Academic Press, London.

Retel-Laurentin, A. (1974): "Sub-fertility in black Africa" in B.K. Adadevoh (ed): Subfertility and infertility in Africa, The Claxton Press, Ibadan: 69-80.

Robinson, W.C. and Kizito, P. (1991): "Understanding recent changes in contraceptive prevalence in Kenya", DHS-World Conference, Washington DC, 5-7 Aug.

Romaniuk, A. (1968): "Infertility in tropical Africa", in J.C. Caldwell and C. Okonjo (eds): The populations of tropical Africa, Longmann, London: 214-224.

Romaniuk, A. (1980): "Increase in natural fertility during the early stages of modernization - Evidence from an African case study: Zaire", Population Studies (34) 2: 293-310.

Schoenmaeckers, R., Shah, I.H., Lesthaeghe, R., Tambashe, O. (1981): "The child-spacing tradition and the postpartum taboo in tropical Africa", in H.J. Page and R. Lesthaeghe (eds): Child-spacing in tropical Africa - Traditions and change, Academic Press, London.

Shapiro, D. and Tambashe, O. (1991): "Women's employment, education and contraceptive behaviour in Kinshasa", IUSSP-seminar on the course of the fertility transition in sub-Saharan Africa, Harare 19-22 Nov.

Tambashe, O. (1984): Niveaux et corrélats de la fécondité à Kinshasa, PhD-dissertation, Interuniversity Programme in Demography, Vrije Universiteit, Brussels.

Table 1: Comparison of the mean durations of the postpartum variables in the sub-Saharan regions covered by both the WFS and DHS-surveys

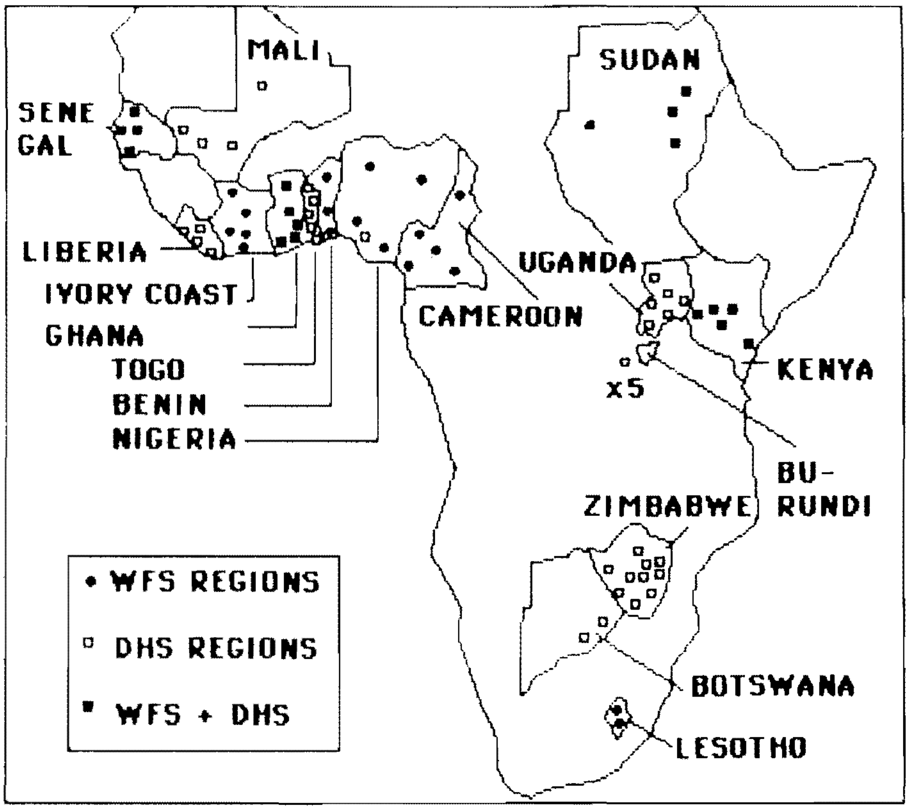
Regions & dates	breastfeeding (months)		p.p. amenorrhoea (months)		p.p. abstinence (months)		overall p.p. non-susceptible period (months)		average length of schooling, women 15-49 (years)	
	WFS	DHS	WFS	DHS	WFS	DHS	WFS	DHS	WFS	DHS
Kenya (1978, 1989)										
Nairobi	14	20	8	9	3	6	9	12	6.2	7.8
Cental, Eastern	17	20	12	10	4	7	13	12	3.7	5.6
Rift Valley	17	19	11	12	6	8	12	14	3.3	4.6
Coast	20	18	15	9	4	3	15	10	2.2	3.9
Western, Nyanza	19	20	12	12	3	4	13	13	3.2	5.0
Ghana (1980, 1988)										
Central, Western	15	19	12	13	7	11	13	17	3.2	4.3
Gr. Accra, Eastern	17	18	12	12	9	12	13	16	5.6	6.3
Volta	22	21	15	15	17	16	20	19	4.5	4.8
Ashanti, Brong A.	19	20	14	14	8	10	15	17	4.8	5.5
Northern, Upper	33	27	19	20	29	27	30	28	0.6	1.3
Senegal (1978, 1986)										
Central	21	20	(14)	18	(5)	4	(15)	18	0.4	0.5
North East	19	19	(13)	16	(6)	11	(14)	19	0.5	0.8
South	23	20	(16)	17	(6)	18	(17)	21	0.6	1.2
West (Dakar, Thies)	19	17	(13)	14	(2)	6	(14)	16	2.0	2.8
Sudan (Northern) (1979, 1989)										
Central	18	20	12	15	3	4	13	15	0.9	2.5
Khartoum	17	16	9	9	3	5	10	11	2.7	5.2
Kordofan, Darfur	18	21	13	17	3	5	14	18	0.6	1.3
North, East	17	20	11	13	4	6	12	14	1.0	2.4

Notes: Durations of postpartum abstinence (and hence also durations of p.p. non-susceptibility) for Senagal were not measured in the WFS. The results presented here stem from other surveys by Cantrelle and Ferry, and Anderson et al. (see Lesthaeghe, 1989: 136 for details). Similarly, the durations of lactational amenorrhoea were estimated from the WFS-results for the length of breastfeeding.

All other mean durations are estimated as prevalence-incidence ratios for births during the last 3 years.

Table 2: Comparison of desired family size, contraceptive knowledge and use in the sub-Saharan regions covered by both the WFS and DHS-surveys

Regions & date	% married desired fam. size LE 4		% knowing at least 1 modern method		% married using modern method	
	WFS	DHS	WFS	DHS	WFS	DHS
Kenya (1978, 1989)						
Nairobi	32	79	93	95	19	28
Central, Eastern	16	68	92	94	9	25
Rift Valley	12	50	81	85	5	18
Coast	15	36	83	92	5	15
Western, Nyanza	17	49	88	92	3	10
Ghana (1980, 1988)						
Central, Western	27	33	76	79	5	4
Gr. Accra, Eastern	37	51	81	90	11	8
Volta	35	46	62	78	6	4
Ashanti, Brong-Ahafo	30	45	59	80	9	6
Northern, Upper	5	7	13	40	1	1
Senegal (1978, 1986)						
Central	11	11	13	70	0	1
North East	12	11	16	39	0	1
South	7	13	14	54	0	2
West (Dakar, Thies)	14	26	38	86	2	6
Sudan (Northern) (1979, 1989)						
Central	37	20	63	80	7	4
Khartoum	41	41	82	96	18	16
Kordofan, Darfur	21	11	27	45	2	1
North, East	28	21	50	74	3	4



Map 1: Location of the countries and regions that participated in the WFS and DHS-surveys.

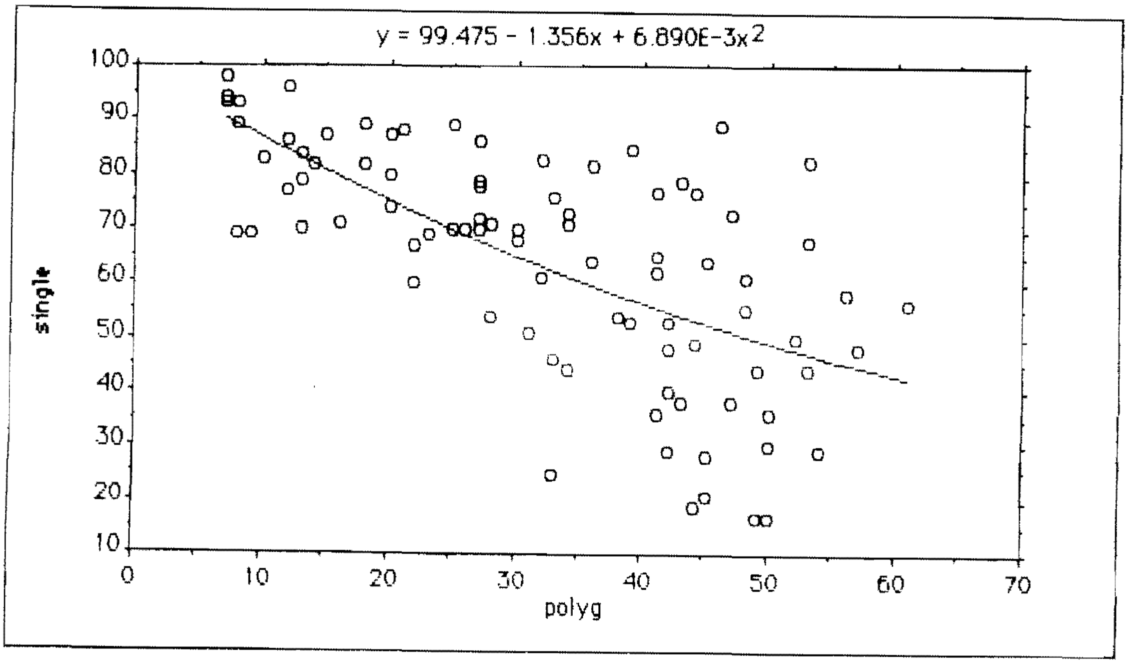


Figure 1: Relationship between the percentage of women 15-19 still single and the percentage of married women 15-49 in polygynous unions; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.65

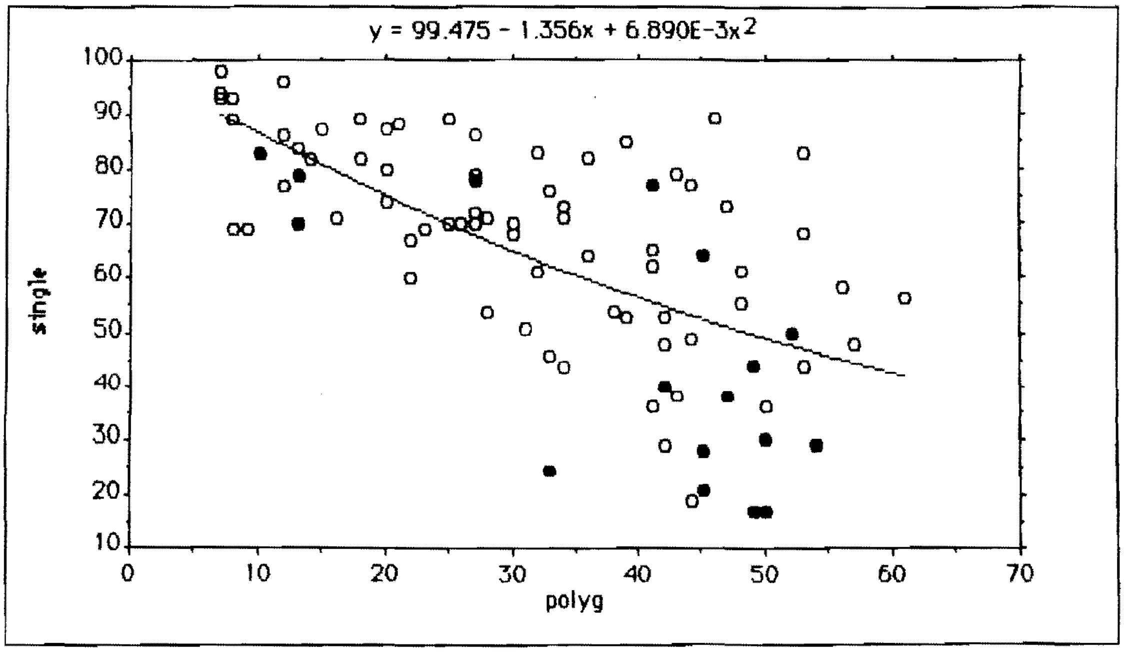


Figure 2: Relationship between the percentage of women 15-19 still single and the percentage of married women 15-49 in polygynous unions; WFS + DHS regions in sub-Saharan Africa.

● areas with more than 75 percent of Islamic women
o other areas

WFS+DHS : % women 15-19 single with mean yrs of educ women. N=92

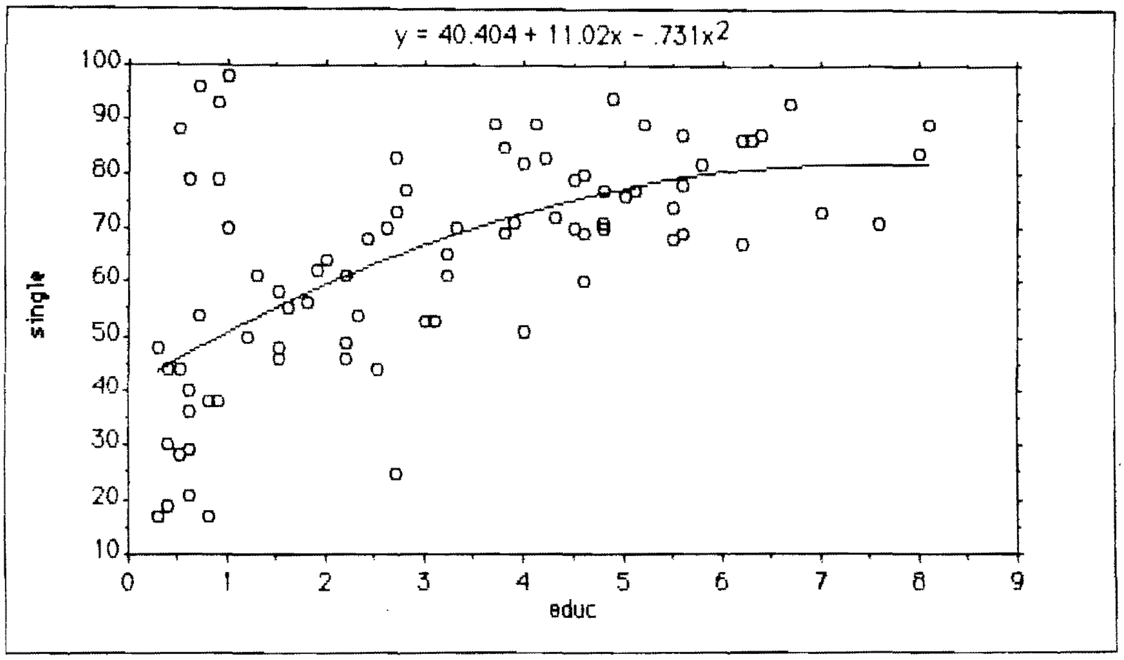


Figure 3: Relationship between the percentage of women still single at ages 15-19 and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.63

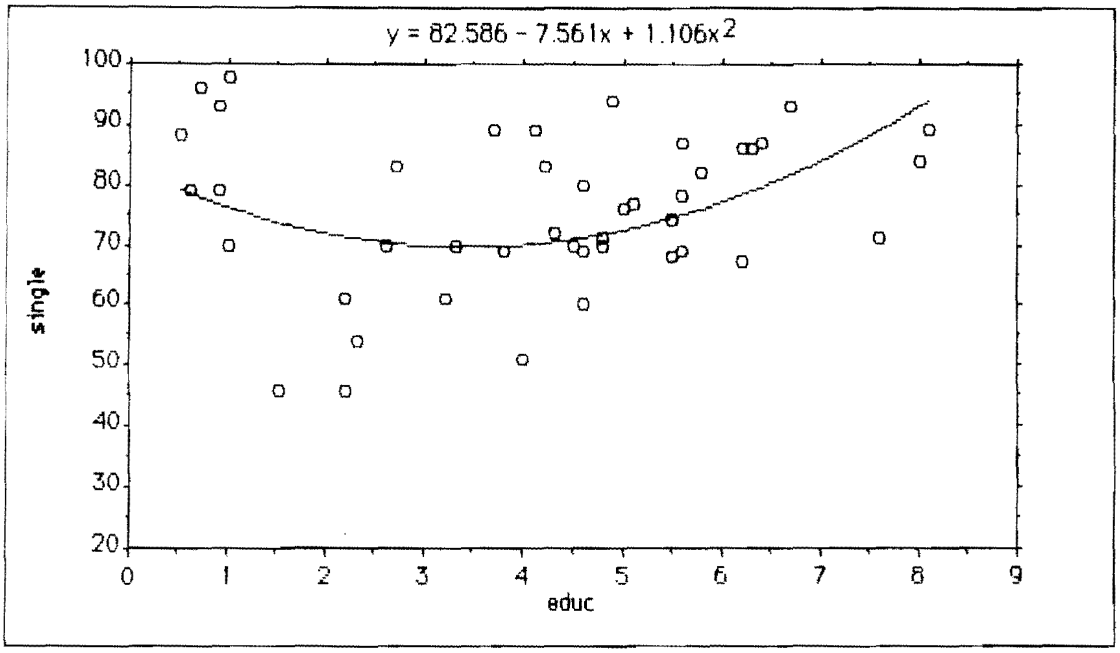


Figure 4: Relationship between the percentage of women 15-19 still single and the mean years of schooling completed by women 15-49 in regions with a low incidence of polygyny (33 percent or less).

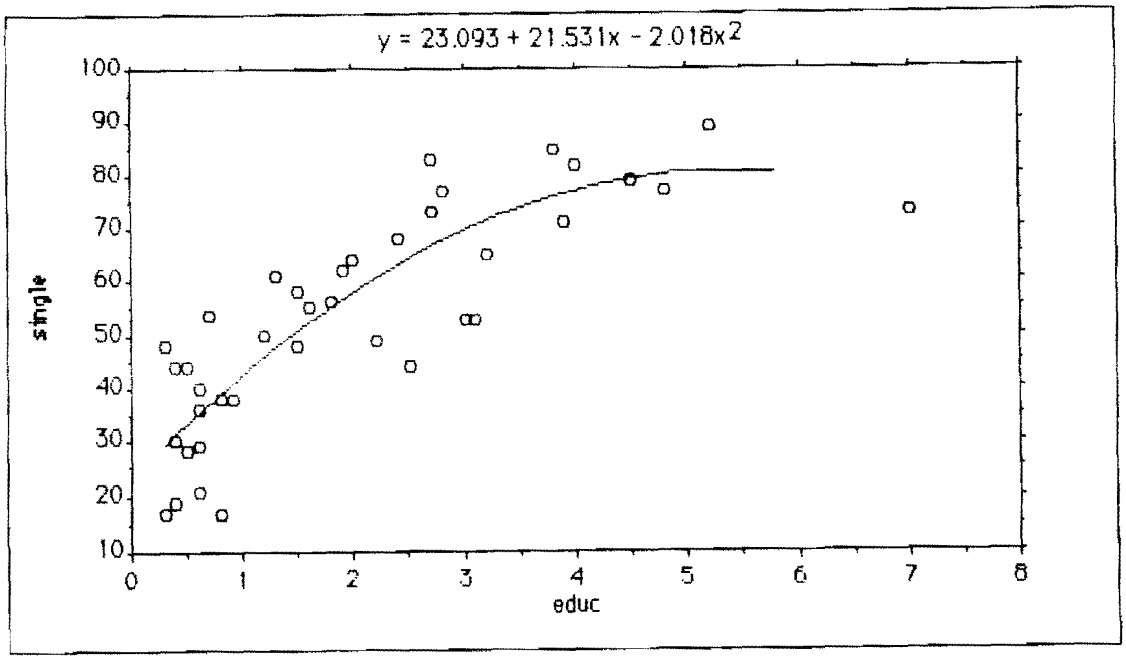


Figure 5: Relationship between the percentage of women 15-19 still single and the mean length of schooling completed by women 15-49 in regions with a high incidence of polygyny (more than 33 percent).

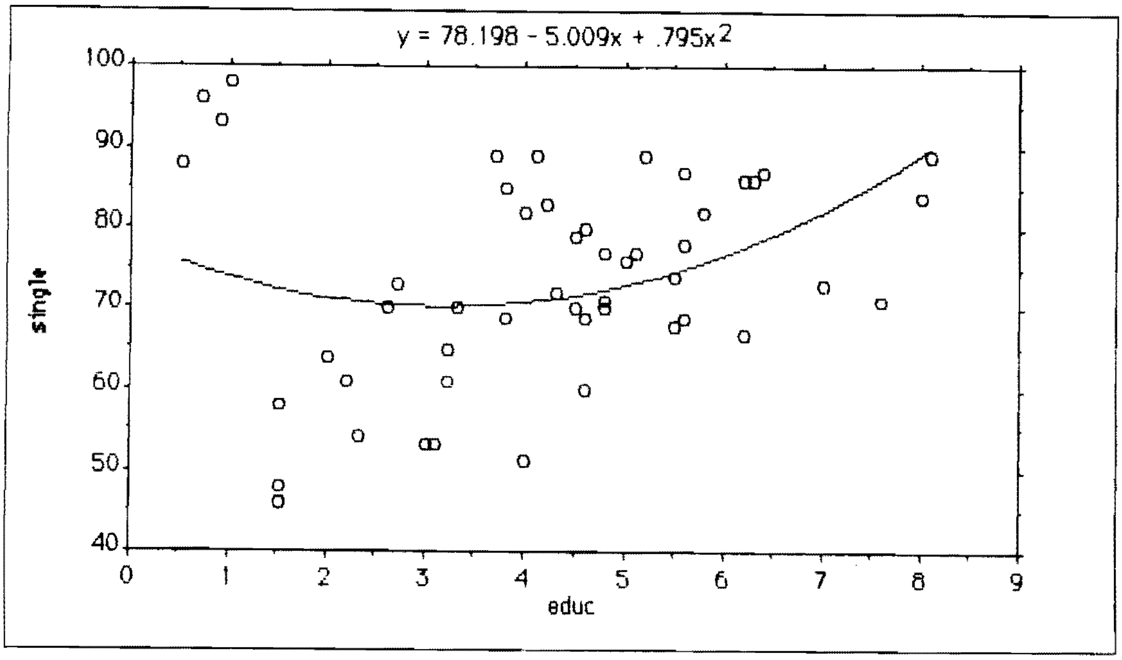


Figure 6: Relationship between the percentage of women 15-19 still single and the mean length of schooling completed by women 15-49 in regions with a Christian majority (more than 50%).

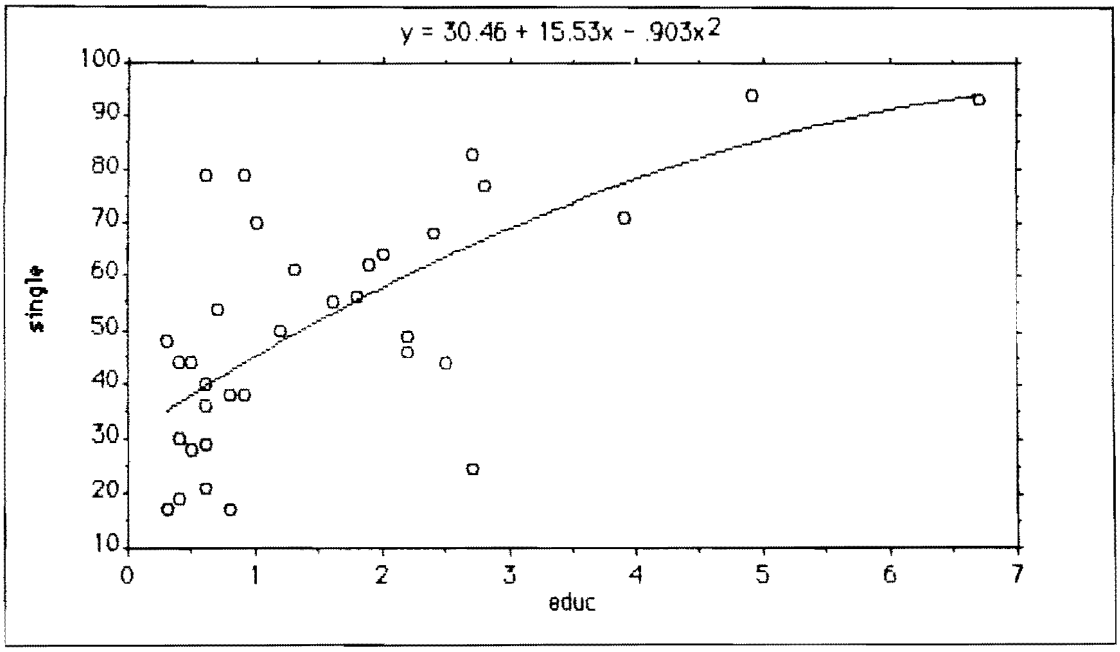


Figure 7: Relationship between the percentage of women 15-19 still single and the mean length of schooling completed by women 15-49 in regions with an non-Christian majority (Islam, traditional & syncretic religions).

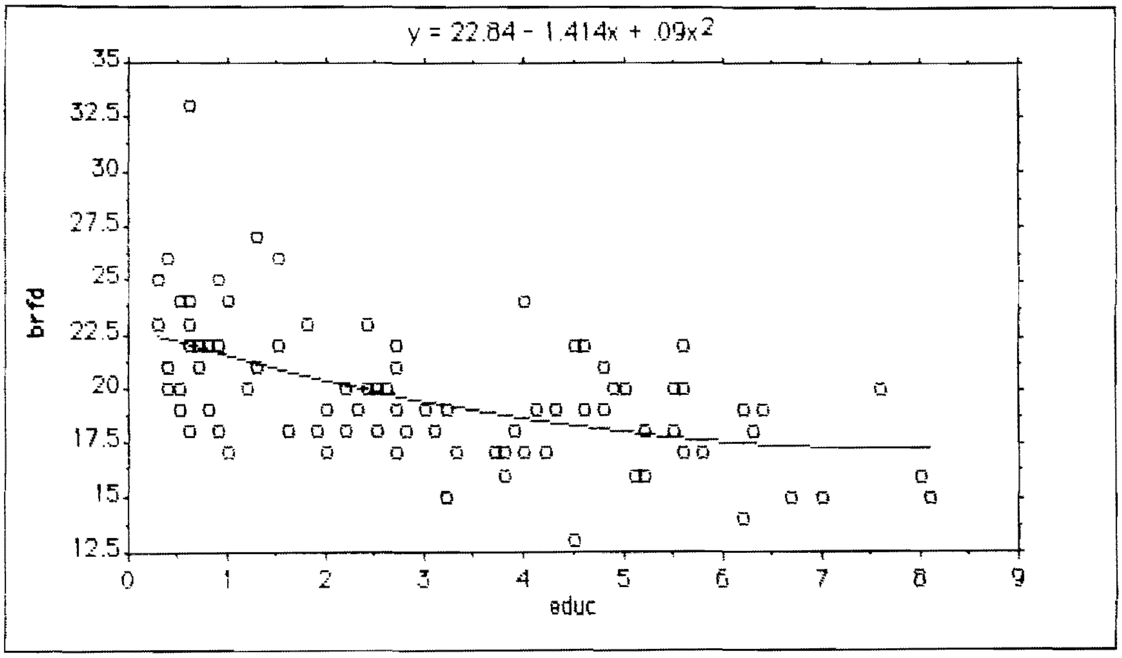


Figure 8: Relationship between the length of breastfeeding in months and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.54

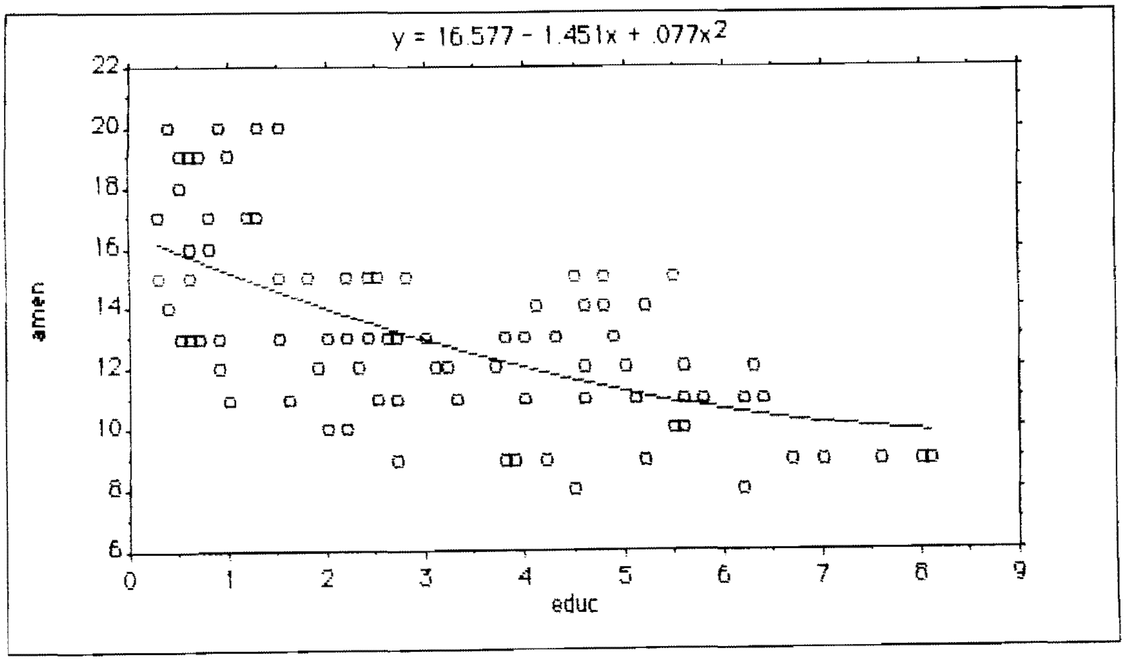


Figure 9: Relationship between the duration of lactational amenorrhoea in months and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.65

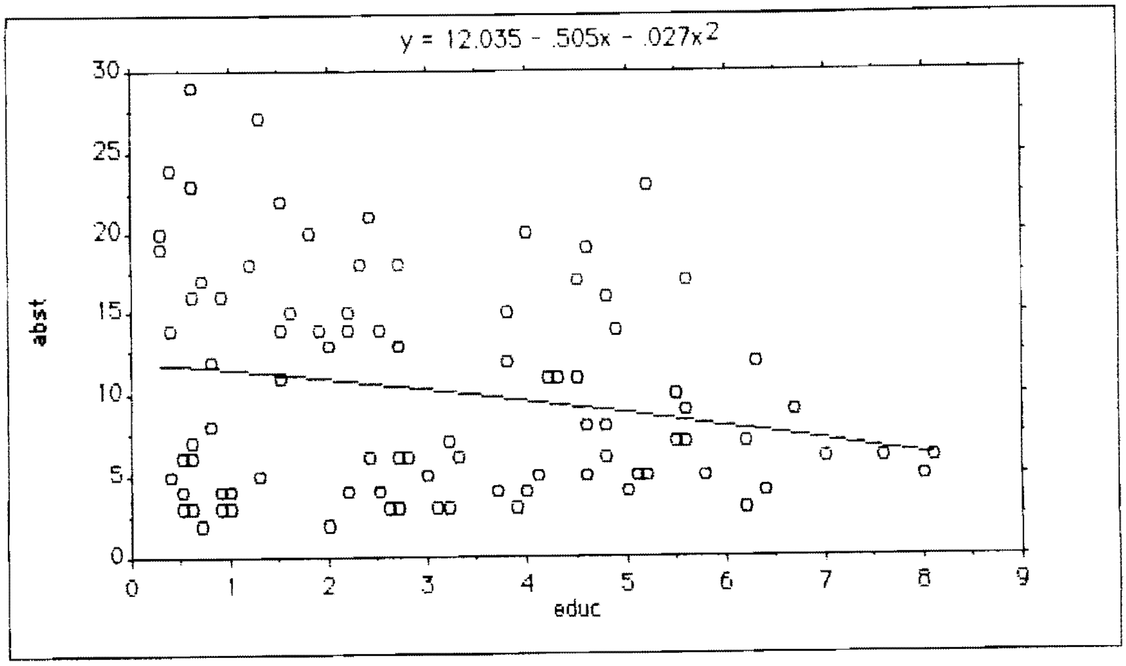


Figure 10: Relationship between the duration of postpartum abstinence in months and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.22

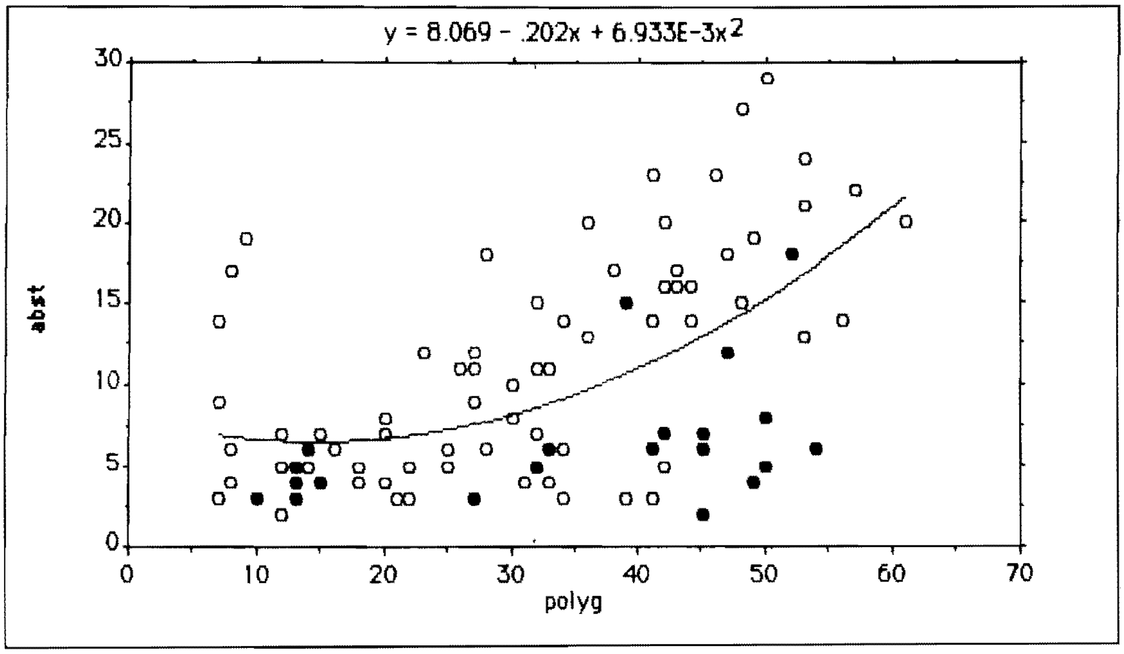


Figure 11: Relationship between the average duration of postpartum abstinence and the percentage of married women 15-49 in polygynous unions; WFS + DHS regions in sub-Saharan Africa.

● areas with more than 75 percent of women Islamic
o other areas

polynomial r = 0.55

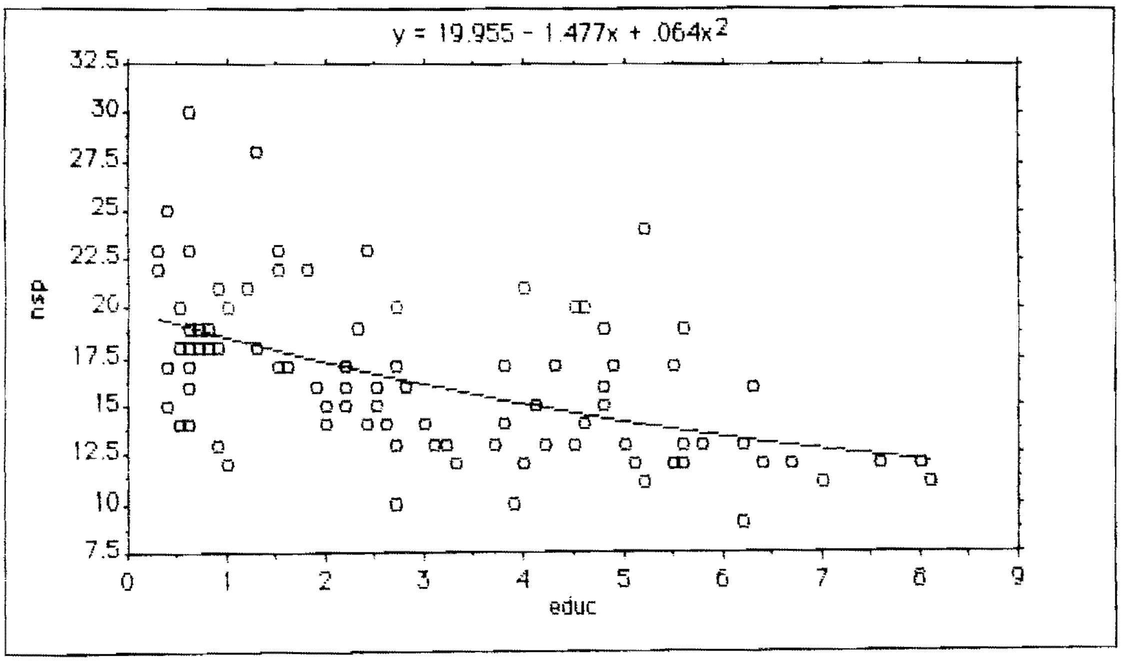


Figure 12: Relationship between the length of the overall postpartum non-susceptible period in months and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.53

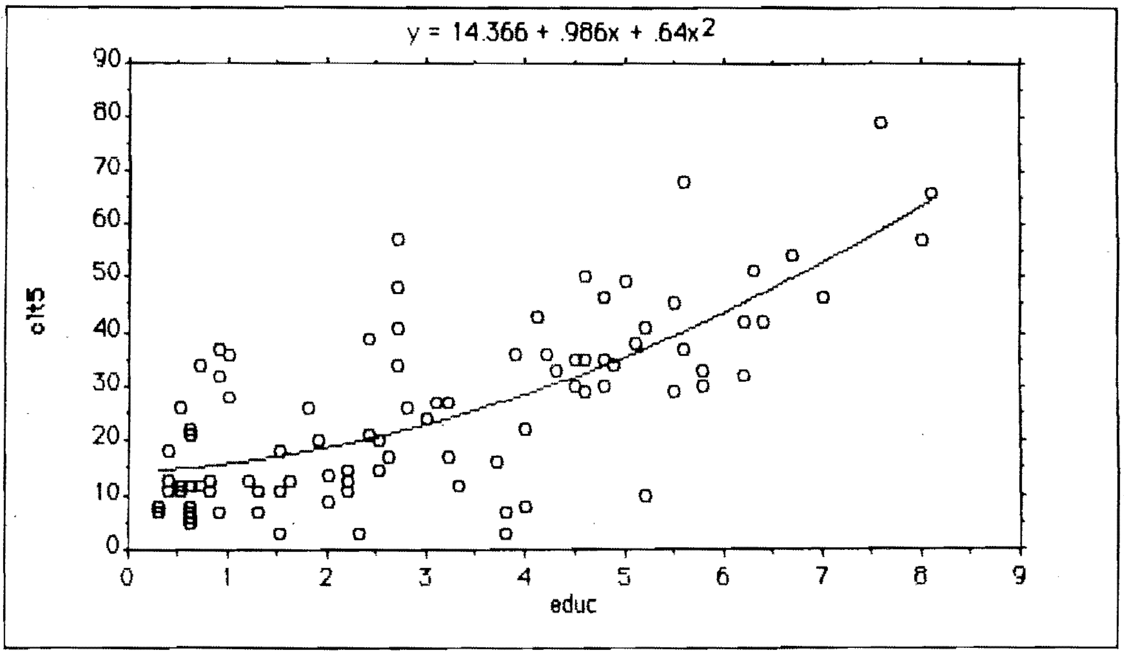


Figure 13: Relationship between the percentage of currently married women 15-49 with desired family sizes of 4 children or less and the mean number of years of female schooling; WFS + DHS regions of sub-Saharan Africa.

polynomial r = 0.73

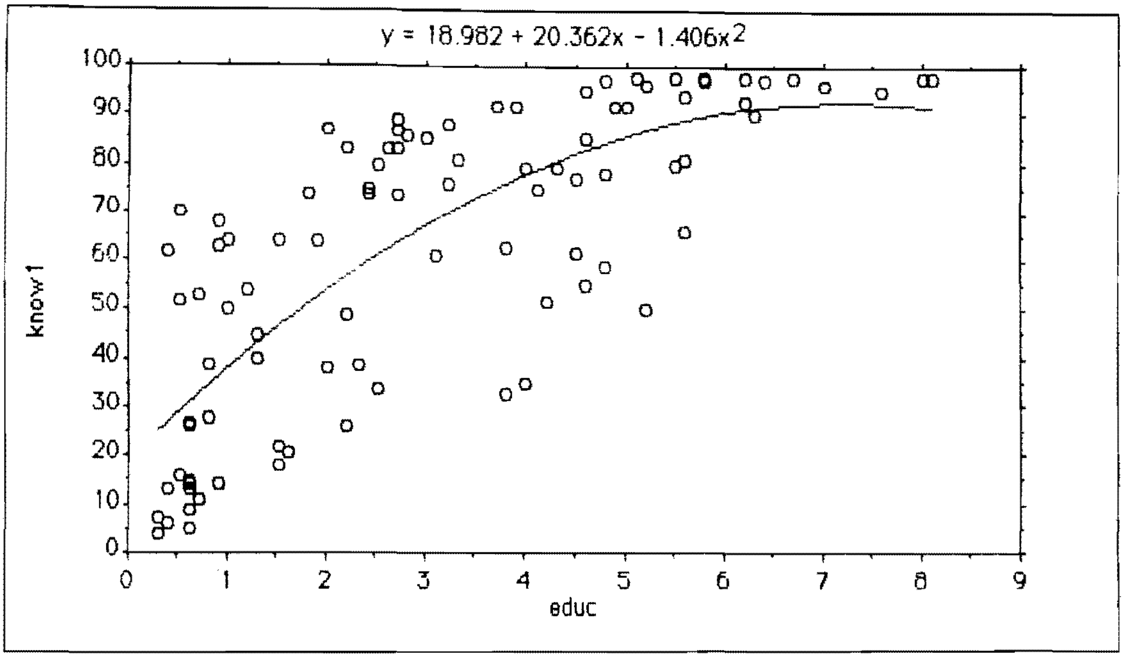


Figure 14: Relationship between the percentage of women 15-49 knowing at least one modern method of contraception and the mean number of years of female schooling; WFS + DHS regions of sub-Saharan Africa.

polynomial r = 0.77

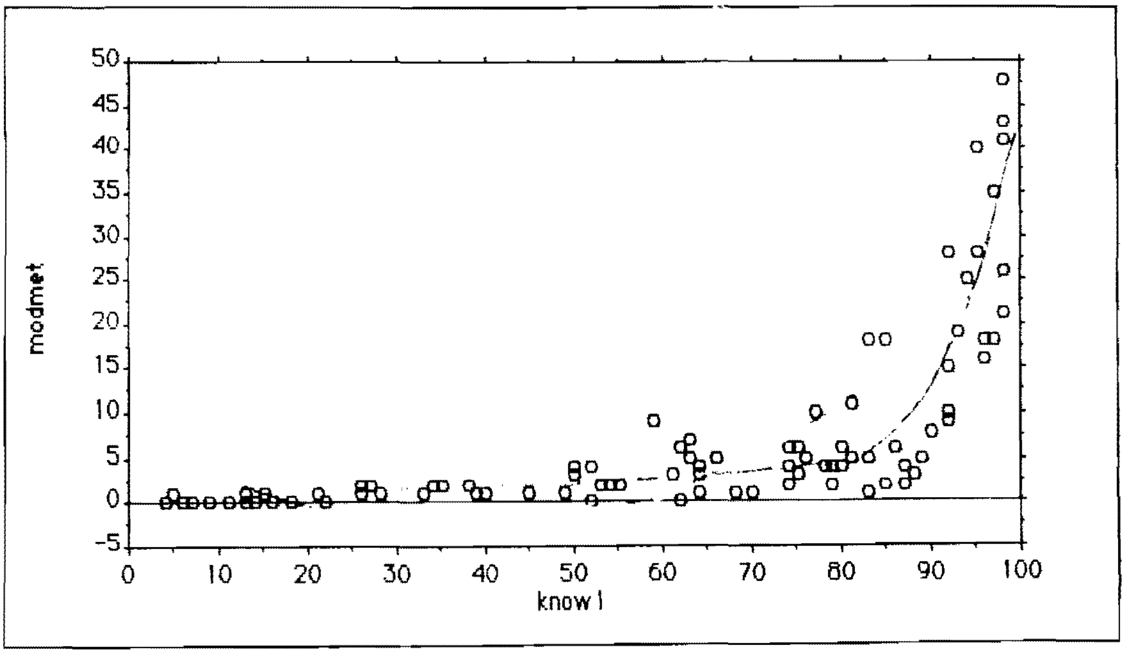


Figure 15: Relationship between the percentage of currently married women 15-49 using modern methods of contraception and the percentage of all women knowing of at least one modern method; WFS + DHS regions of sub-Saharan Africa.

polynomial r = 0.80

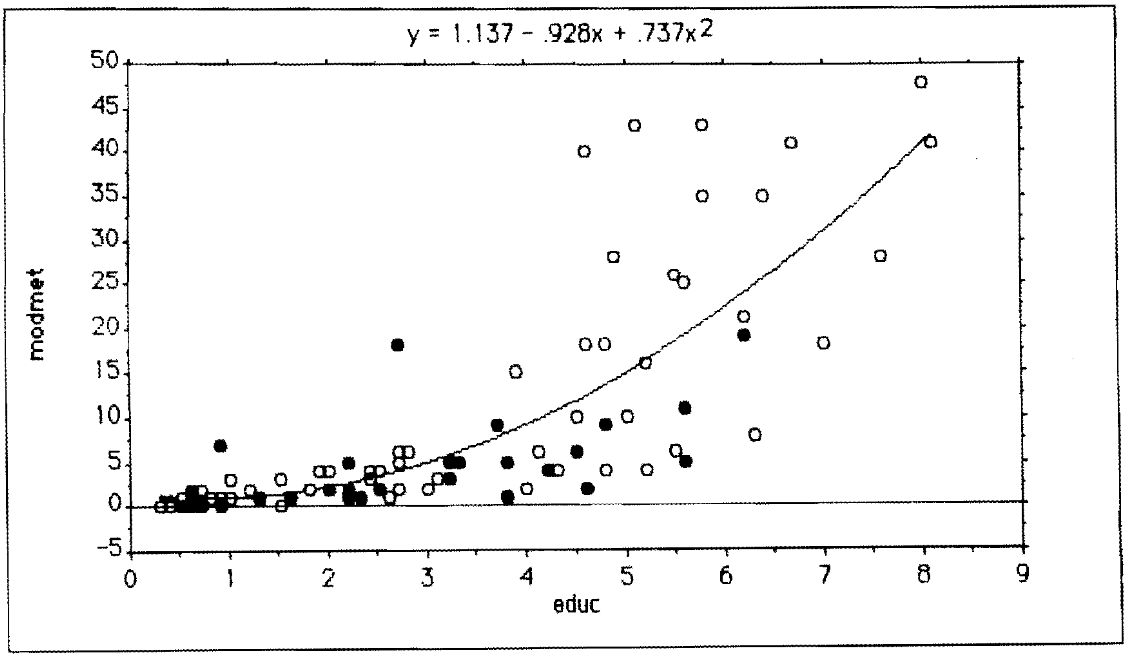


Figure 16: Relationship between the percentage of currently married women 15-49 using modern methods of contraception and the mean number of years of female schooling; WFS + DHS regions of sub-Saharan Africa.

● : WFS
o : DHS

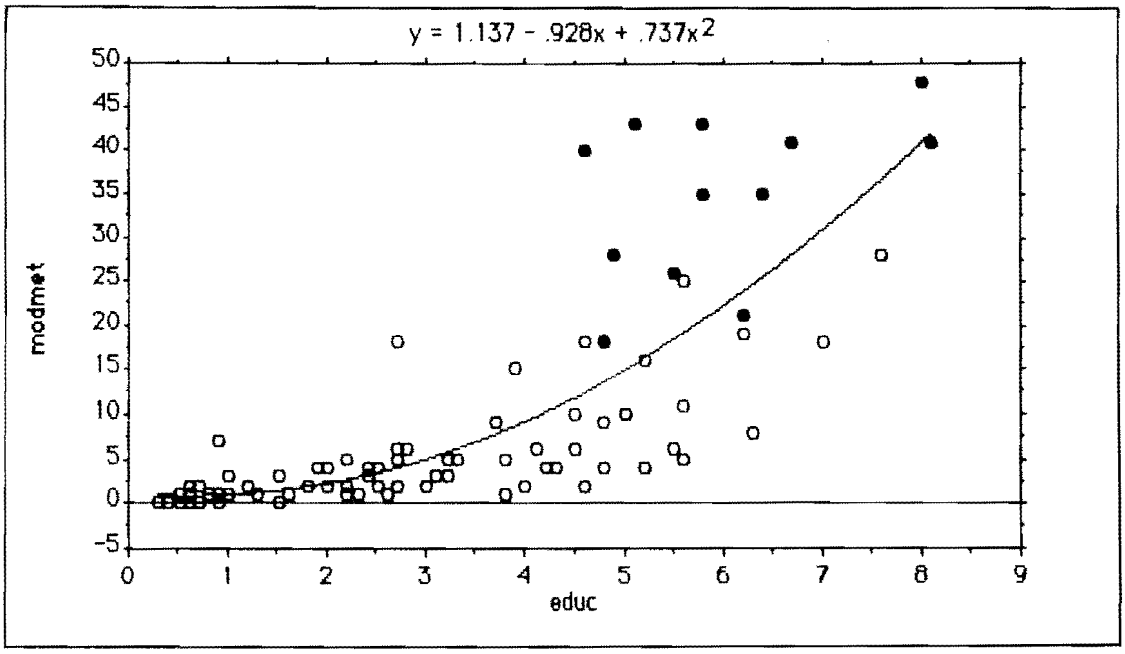


Figure 17: Relationship between the percentage of currently married women using modern methods and the mean years of education; WFS + DHS regions in sub-Saharan Africa.

● = regions of Zimbabwe and Botswana (DHS)
o = other regions

polynomial r = 0.80

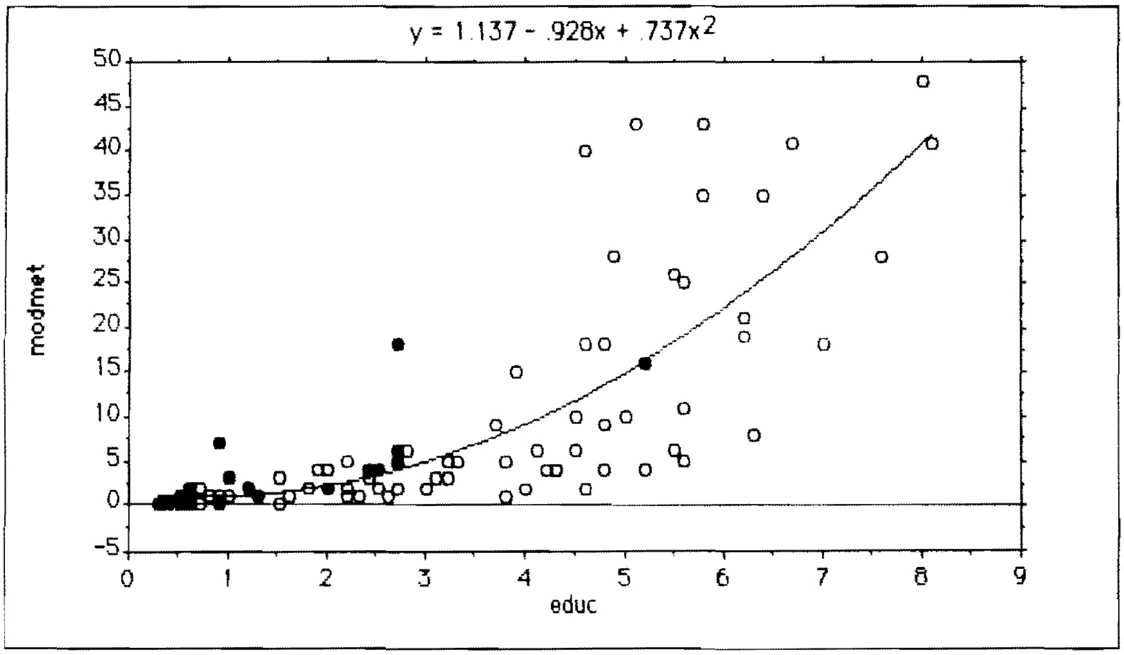


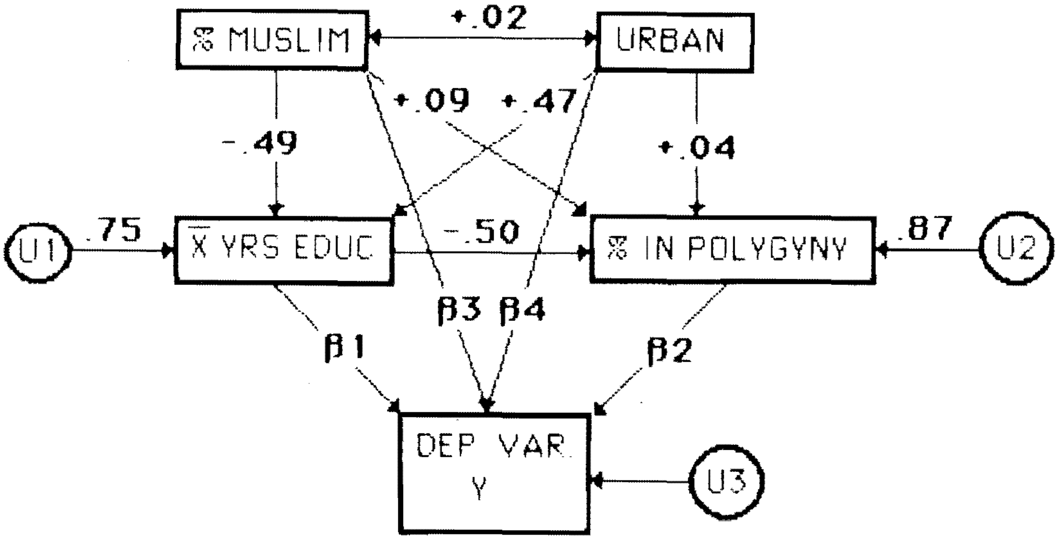
Figure 18: Relationship between the percentage of currently married women using modern methods and the mean years of female education; WFS and DHS regions in sub-Saharan Africa.

• areas with more than 75 percent of Islamic women
o other areas

polynomial r = 0.80

FIGURE 19

REGRESSION MODEL FOR VARIOUS DEMOGRAPHIC DEPENDENT VARIABLES - DHS REGIONS, N=55



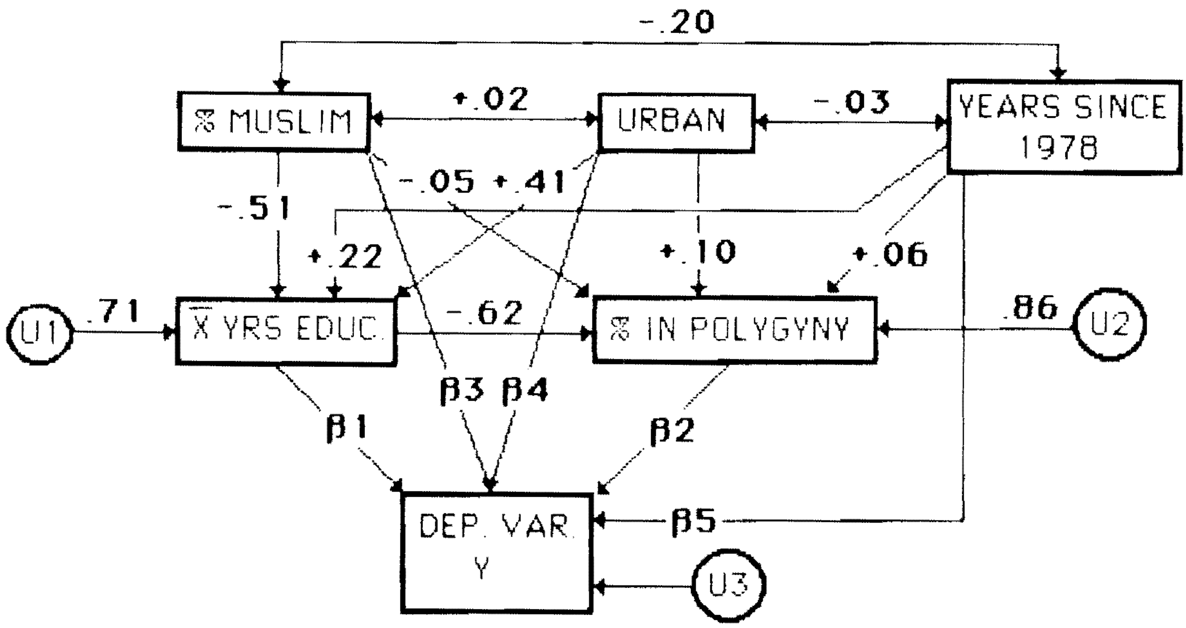
DEP. VAR. Y	β1	β2	β3	β4	R^2_{adj}	U3
% SINGLE 15-19	- 03	- 33**	- 58**	+ 16	63	.61
X̄ BREASTFEEDING	-.72**	+ 02	- 26*	- 14	50	.71
X̄ AMENORRHEA	- 82**	- 08	- 11	- 09	.59	64
X̄ PP. ABSTINENCE	+.07	+ 71**	- 23	-.02	38	79
X̄ PP. NON-SUSCEPT.	-.60**	+ 29*	- 26*	- 04	.49	71
% DES. FAM. SIZE LE 4	+.39**	- 13	-.26*	+.32**	61	.62
% KNOW 1+ MOD. METH.	+.62**	- 09	-.15	+.04	.56	.66
CONTRAC. USE-EFF.	+ 72**	-.24*	-.01	-.09	.67	.57
% USERS MOD. METH	+ 71**	-.27**	+.04	-.10	.65	.59

* sign. at .05 ** sign. at .01

N=51 for analysis of % single due to missing values for 4 regions of Northern Sudan.

FIGURE 20

REGRESSION MODEL FOR VARIOUS DEMOGRAPHIC DEPENDENT VARIABLES – WFS+DHS REGIONS N=92



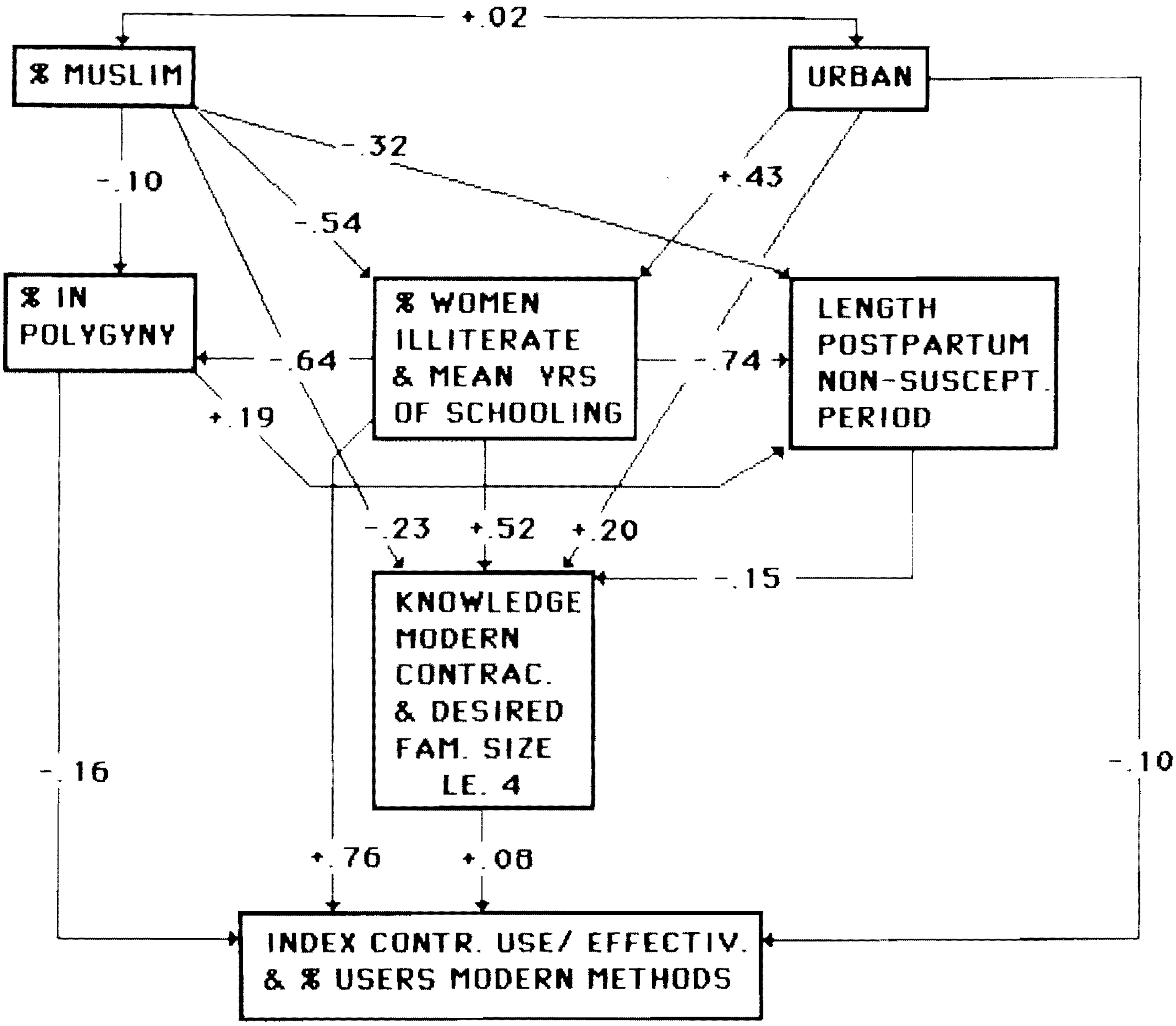
DEP. VAR. Y	β1	β2	β3	β4	β5	R^2_{adj}	U3
% SINGLE 15-19	+.07	-.44**	-34**	+.14	+.12	.57	65
x̄ BREASTFEEDING	-.60**	+.12	-26*	-.15	+19*	.38	79
x̄ AMENORRHEA	-.68**	+.06	-.13	-20*	+.29**	.54	.68
x̄ PP. ABSTINENCE	-.10	+.54**	-36**	-00	-.12	.32	82
x̄ PP NON-SUSCEPT	-.54**	+32**	-33**	-.08	+.10	.43	75
% DES. FAM. SIZE LE 4	+42**	-24**	+.01	+.15*	+34**	.61	.62
% KNOW 1+ MOD. METH	+54**	-20**	-.03	-.04	+29**	.64	.60
CONTRAC. USE-EFF.	+62**	-22**	+.07	-.06	+27**	.66	59
% USERS MOD. METH	+65**	-.25**	+12	-.06	+16*	.62	62

* sign. at .05   ** sign. at 01

N=88 for analysis of % single due to missing values for 4 regions of Northern Sudan.

FIGURE 21

CONTRACEPTIVE USE SUB-SAHARAN AFRICA --LISREL MODEL FOR THE 55 DHS-REGIONS.



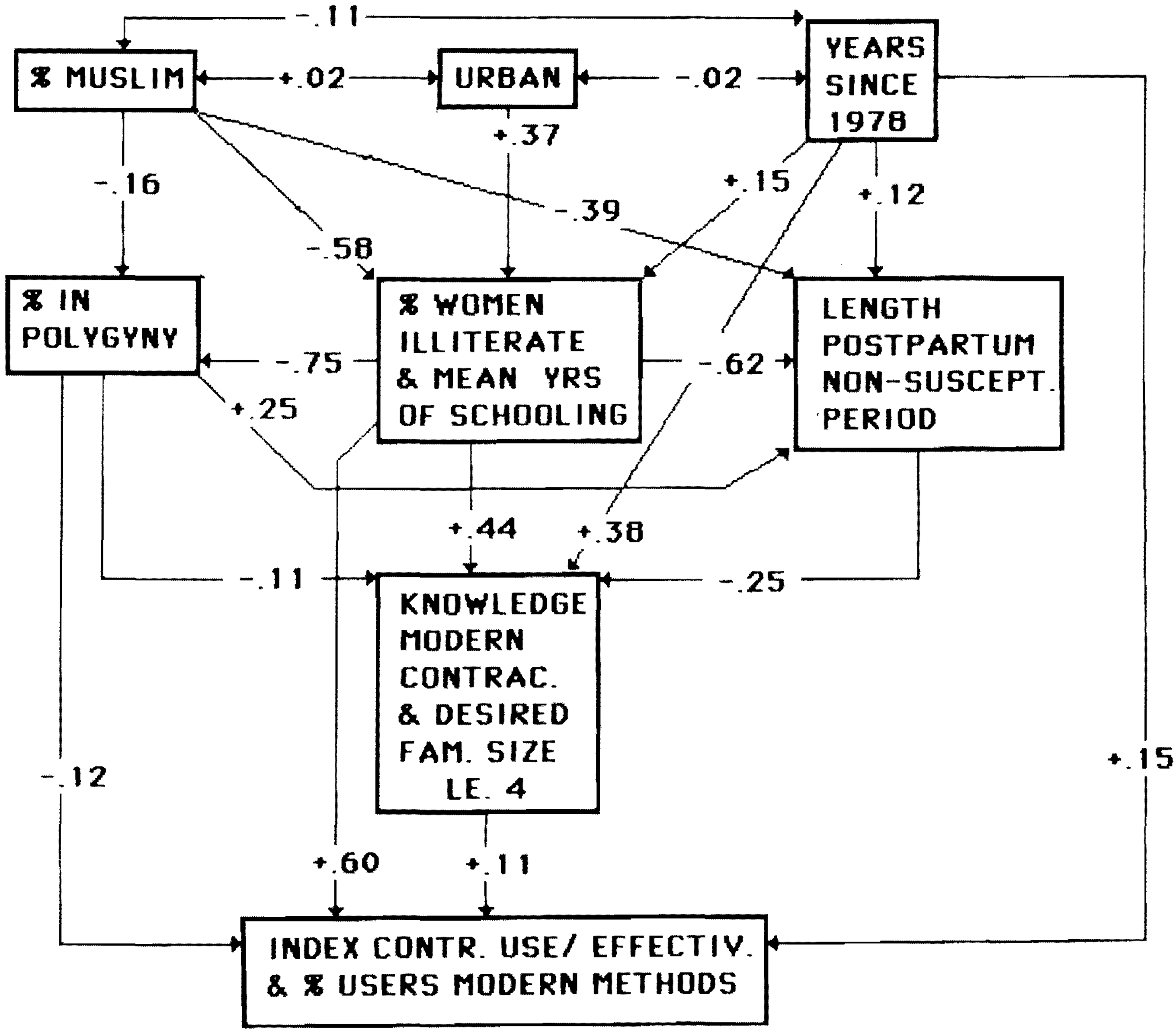
DEP. VAR	R^2
POLYG.	.37
LITERACY	.46
NON SUSC.	.58
KNOWL & DES. FAM. S.	.76
CONTR. USE	.71

ADJ. GOODNESS OF FIT = .987
ROOT MEAN SQUARE RESIDUAL =.053

VERLEYE, LESTHAEGHE & JOLLY 1992

FIGURE 22

CONTRACEPTIVE USE SUB-SAHARAN AFRICA --LISREL MODEL FOR THE POOLED WFS REGIONS (N=37) AND THE DHS REGIONS (N=55)



DEP. VAR	R^2
POLYG.	.39
LITERACY	.51
NON SUSC.	.49
KNOWL & DES. FAM. S.	.79
CONTR. USE	.64

ADJ. GOODNESS OF FIT = .989
ROOT MEAN SQUARE RESIDUAL =.043

VERLEYE, LESTHAEGHE & JOLLY 1992

WFS+DHS . 1000*(log Ci+log Cc) with 1000*(logCi-logCc). N=92

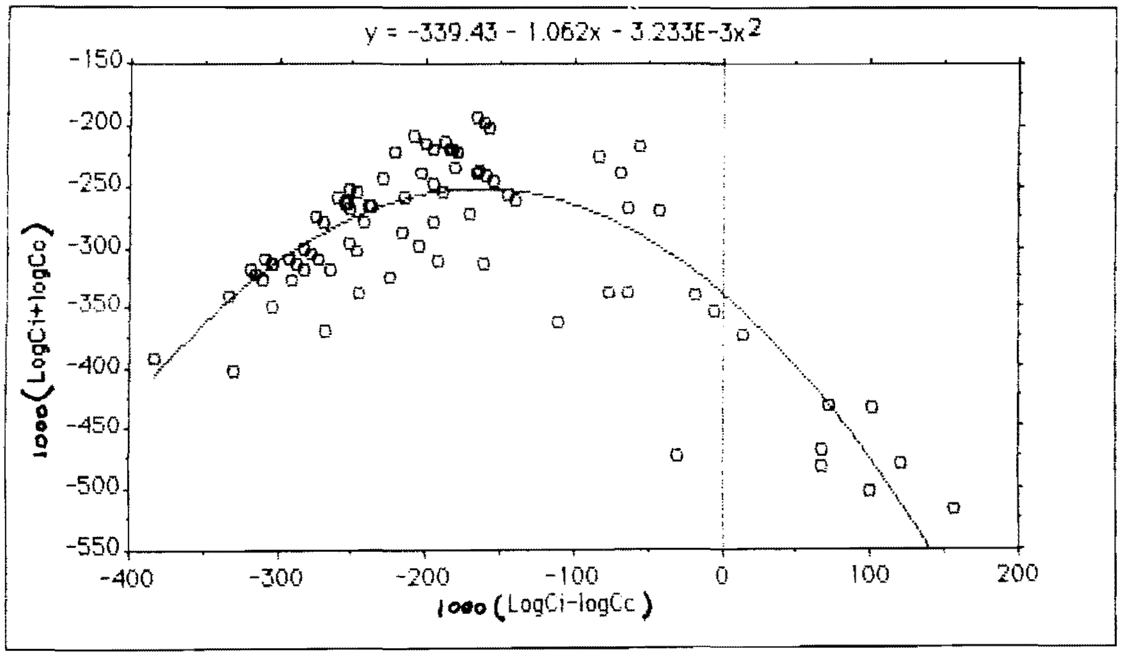


Figure 23: Relationship between the total degree of fertility reduction (vertical axis) and the difference between the shares of postpartum non-susceptibility and of contraception; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.86

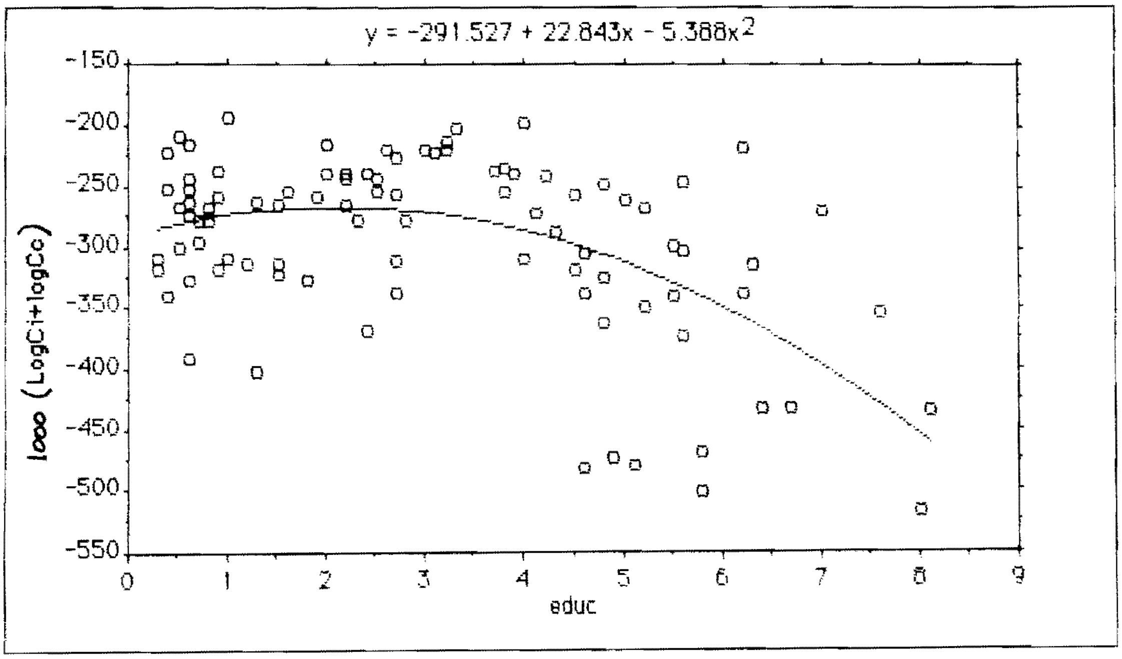


Figure 24: Relationship between the joint fertility reducing effects of postpartum non-susceptibility and of contraception, and the average length of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.54

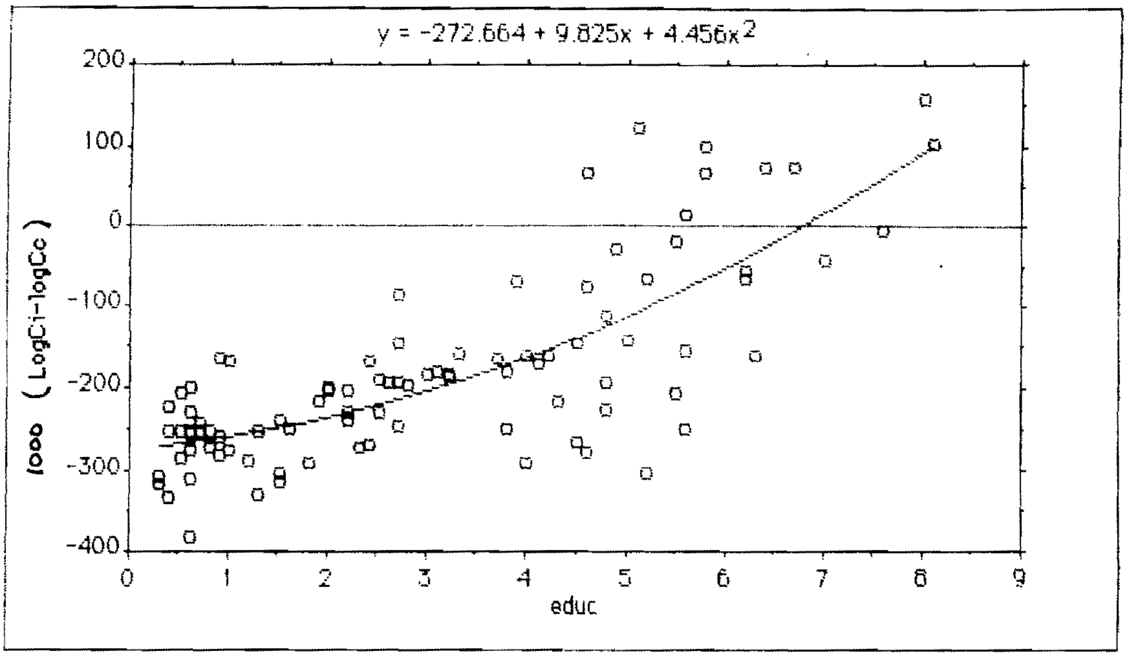
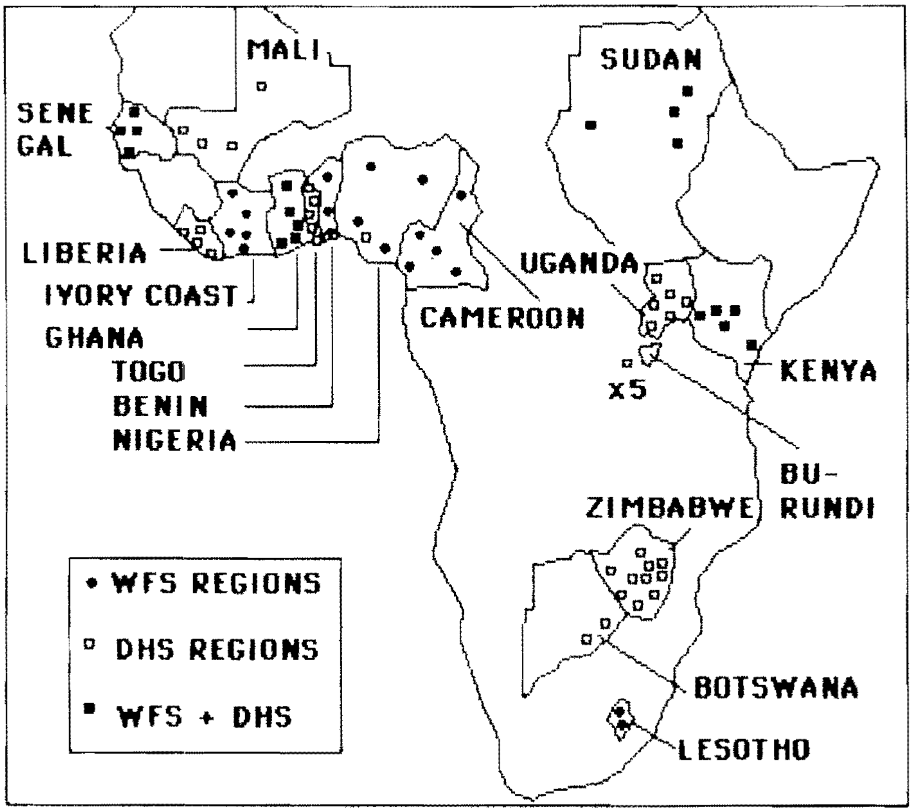


Figure 25: Relationship between the growing impact of fertility reduction via contraception over postpartum non-susceptibility, and the average length of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.77



Map 1: Location of the countries and regions that participated in the WFS and DHS-surveys.

WFS+DHS : % women 15-19 single with % women 15-49 in polygynous unions. N=92

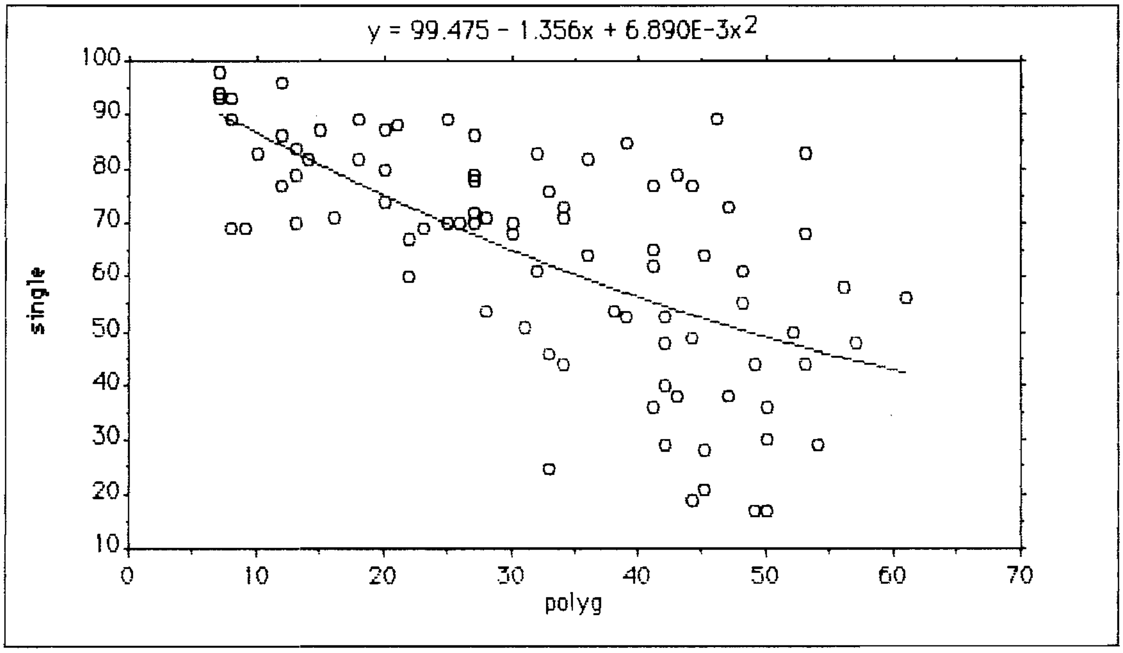


Figure 1: Relationship between the percentage of women 15-19 still single and the percentage of married women 15-49 in polygynous unions; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.65

WFS+DHS : % women 15-19 single with % women 15-49 in polygynous unions. N=92

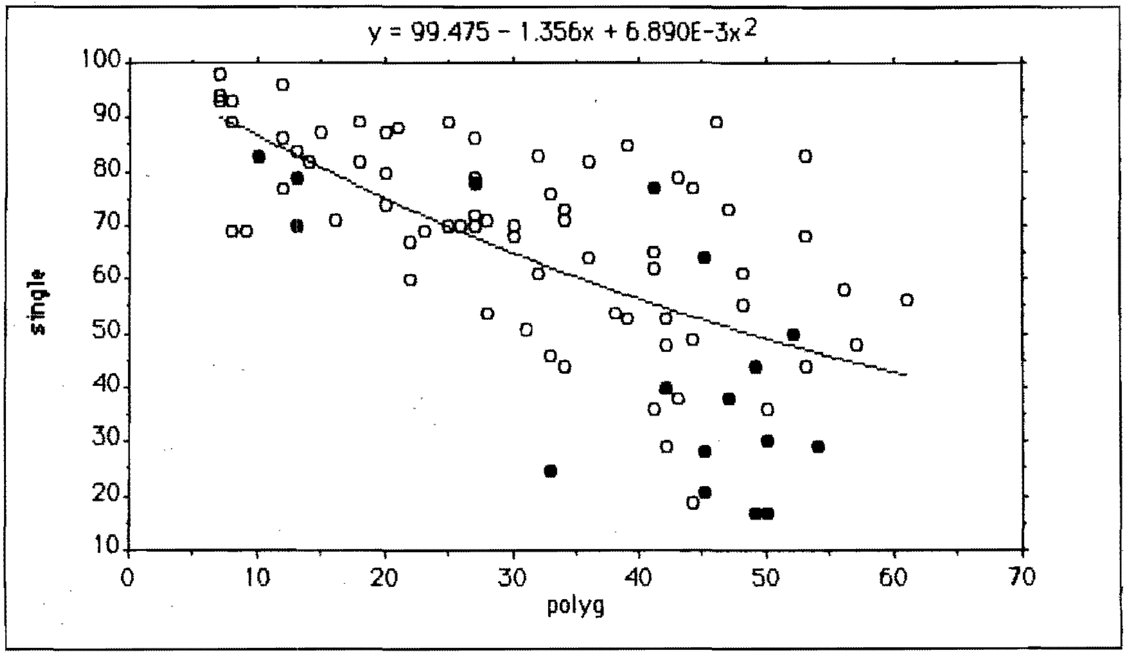


Figure 2: Relationship between the percentage of women 15-19 still single and the percentage of married women 15-49 in polygynous unions; WFS + DHS regions in sub-Saharan Africa.

● areas with more than 75 percent of Islamic women
o other areas

WFS+DHS : % women 15-19 single with mean yrs of educ women. N=92

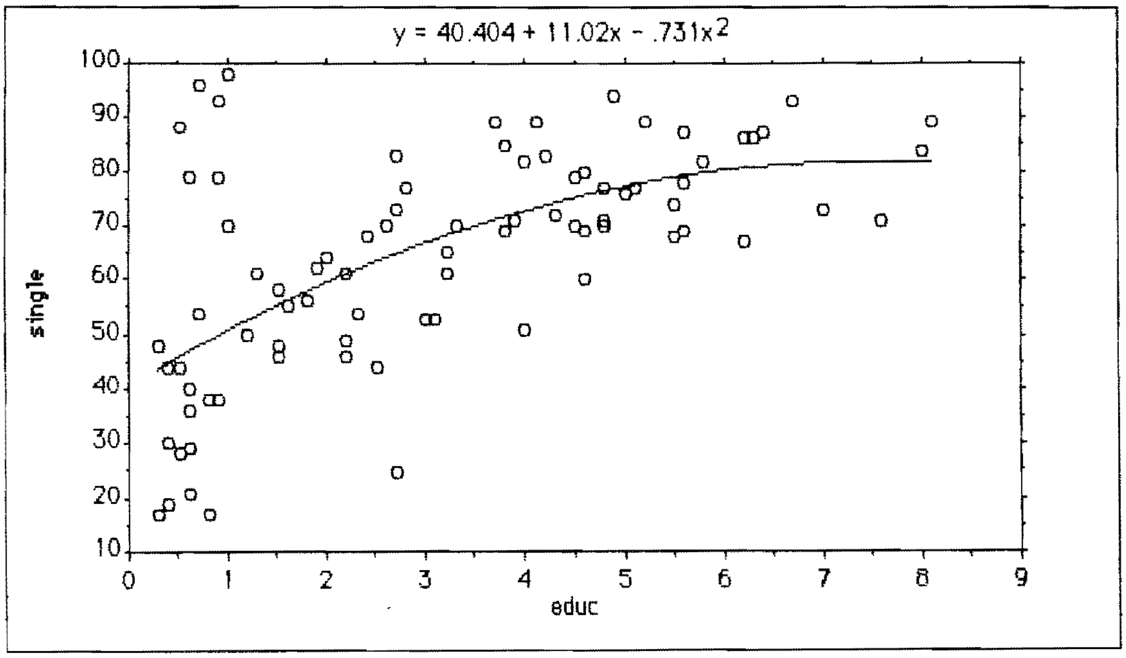


Figure 3: Relationship between the percentage of women still single at ages 15-19 and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.63

WFS+DHS : % women 15-19 single with mean yrs of educ. (low polygyny)

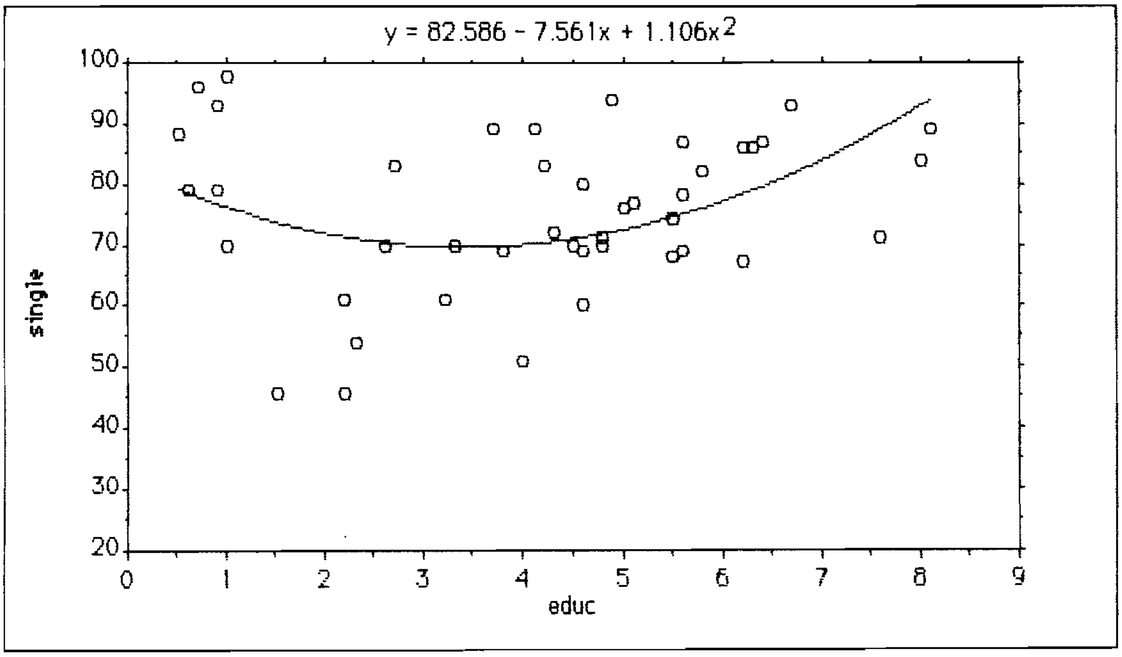


Figure 4: Relationship between the percentage of women 15-19 still single and the mean years of schooling completed by women 15-49 in regions with a low incidence of polygyny (33 percent or less).

WFS+DHS : % women 15-19 single with mean yrs of educ. (high polygyny)

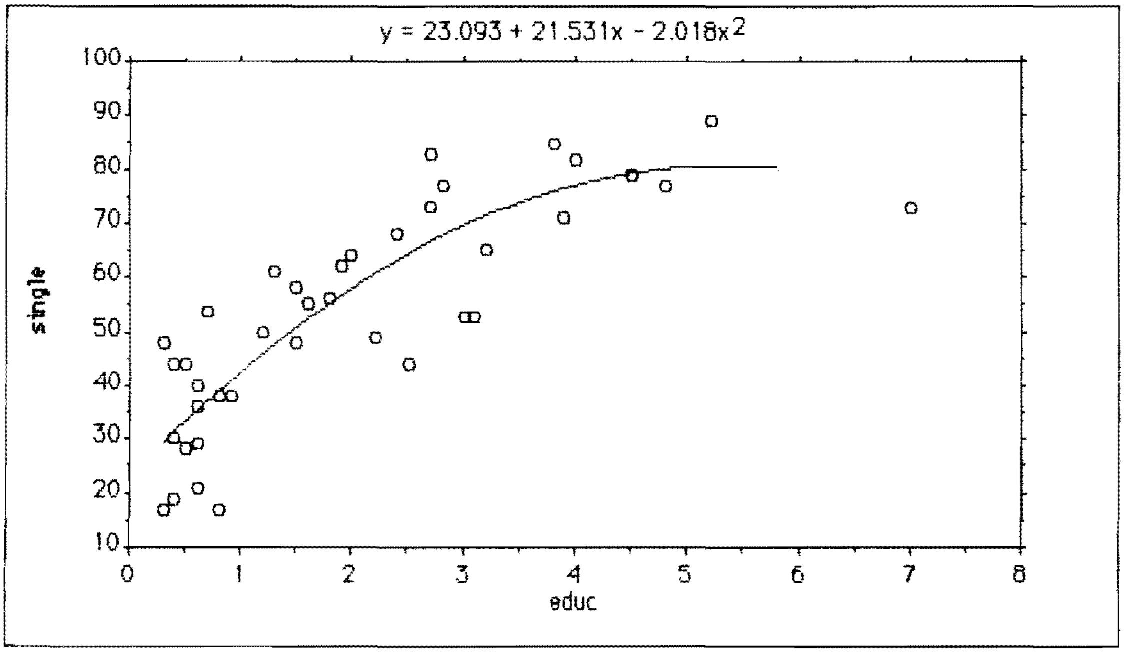


Figure 5: Relationship between the percentage of women 15-19 still single and the mean length of schooling completed by women 15-49 in regions with a high incidence of polygyny (more than 33 percent).

WFS+DHS : % women 15-19 single with mean yrs educ. (Christian)

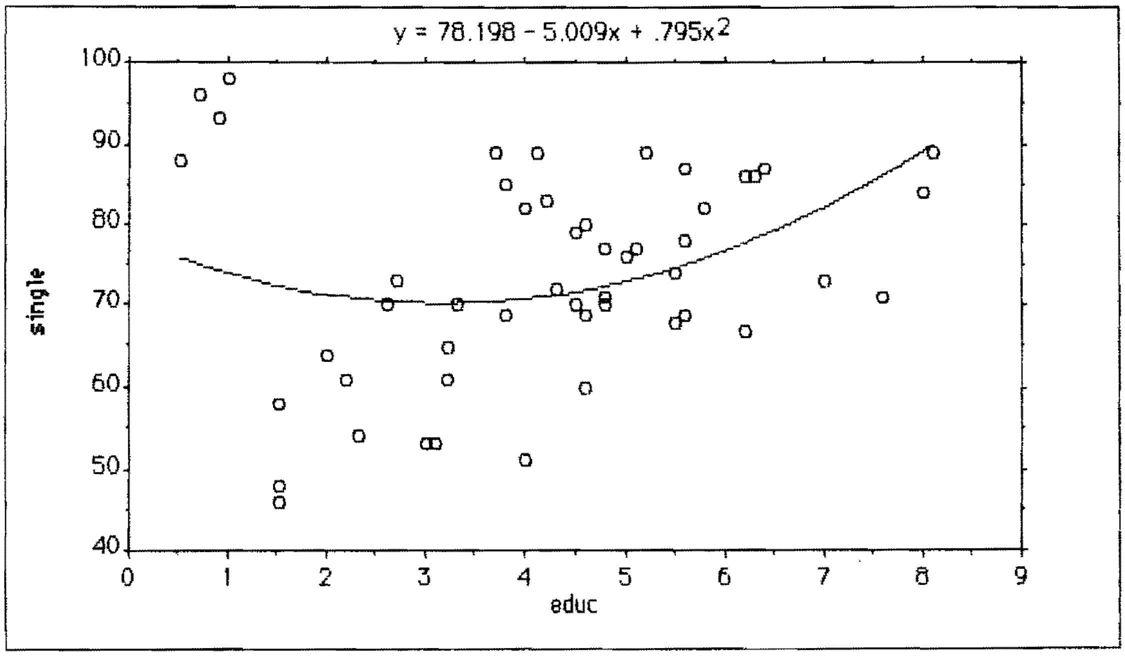


Figure 6: Relationship between the percentage of women 15-19 still single and the mean length of schooling completed by women 15-49 in regions with a Christian majority (more than 50%).

WFS+DHS : % women 15-19 single with mean yrs of educ.(non-Christian))

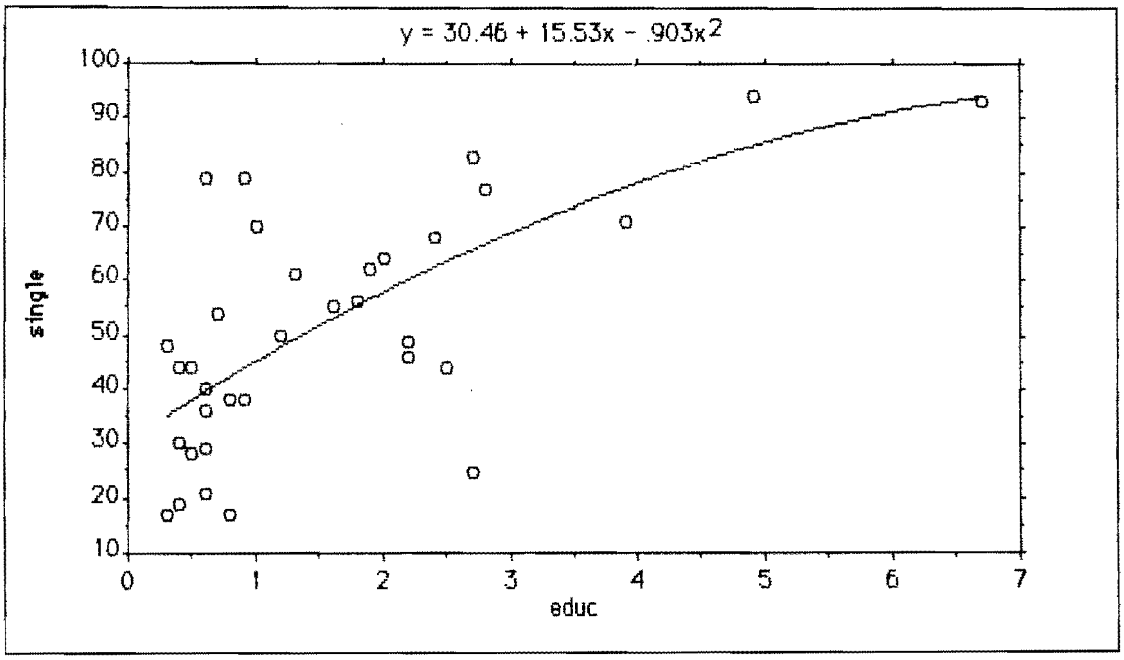


Figure 7: Relationship between the percentage of women 15-19 still single and the mean length of schooling completed by women 15-49 in regions with an non-Christian majority (Islam, traditional & syncretic religions).

WFS+DHS : Breastfeeding with mean yrs. of educ. N=92

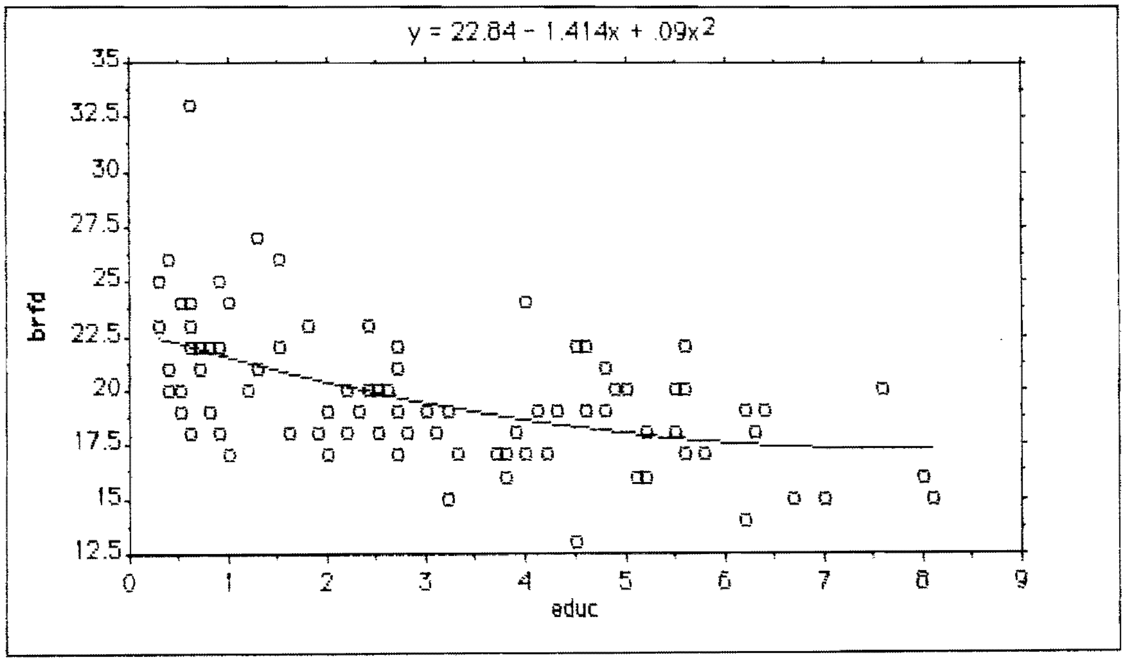


Figure 8: Relationship between the length of breastfeeding in months and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.54

WFS+DHS : Postp. amenorrhoea with mean yrs. of educ. N=92

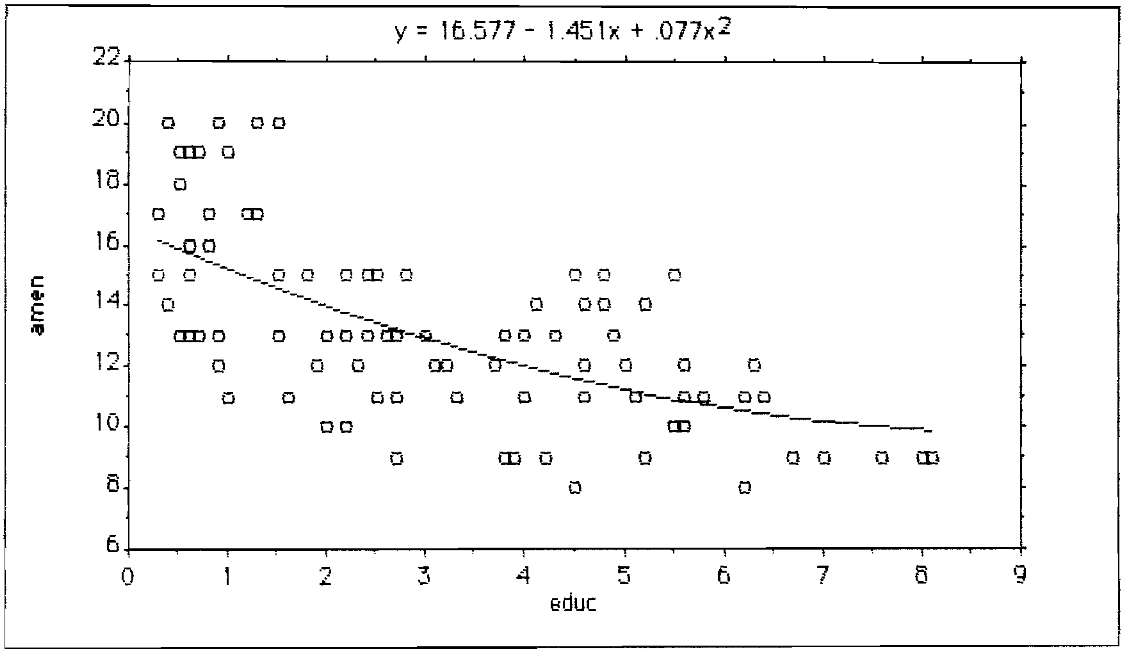


Figure 9: Relationship between the duration of lactational amenorrhoea in months and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.65

WFS+DHS : Postp. abstinence with mean yrs. educ. N=92

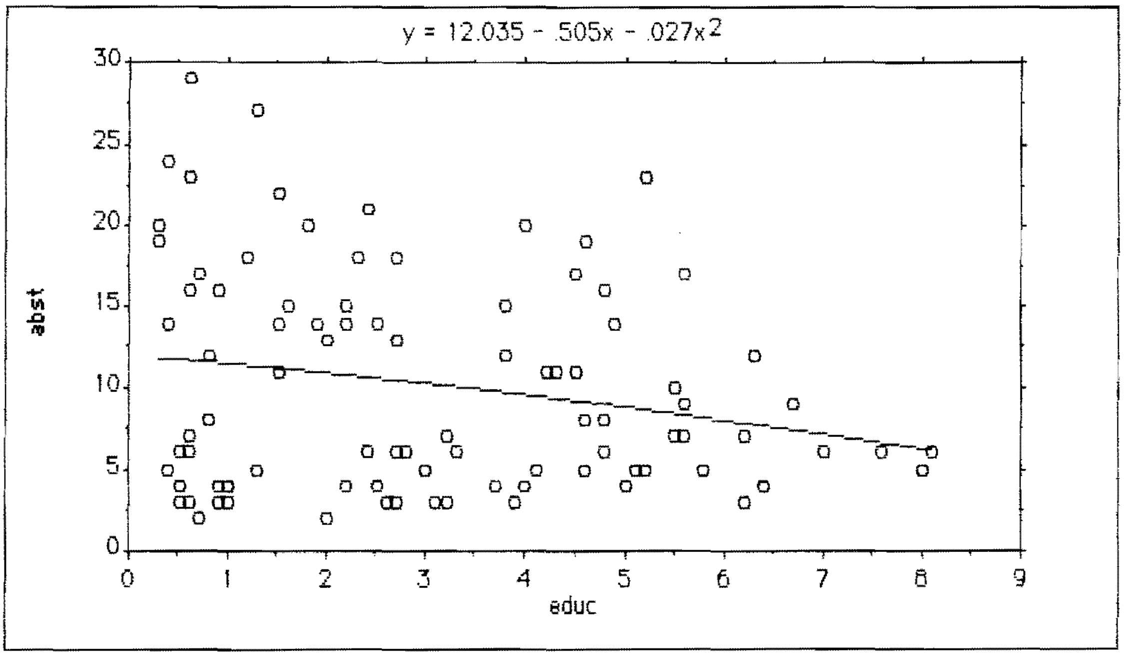


Figure 10: Relationship between the duration of postpartum abstinence in months and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.22

WFS+DHS : pp. abstinence with % women 15-49 in polygynous unions. N=92

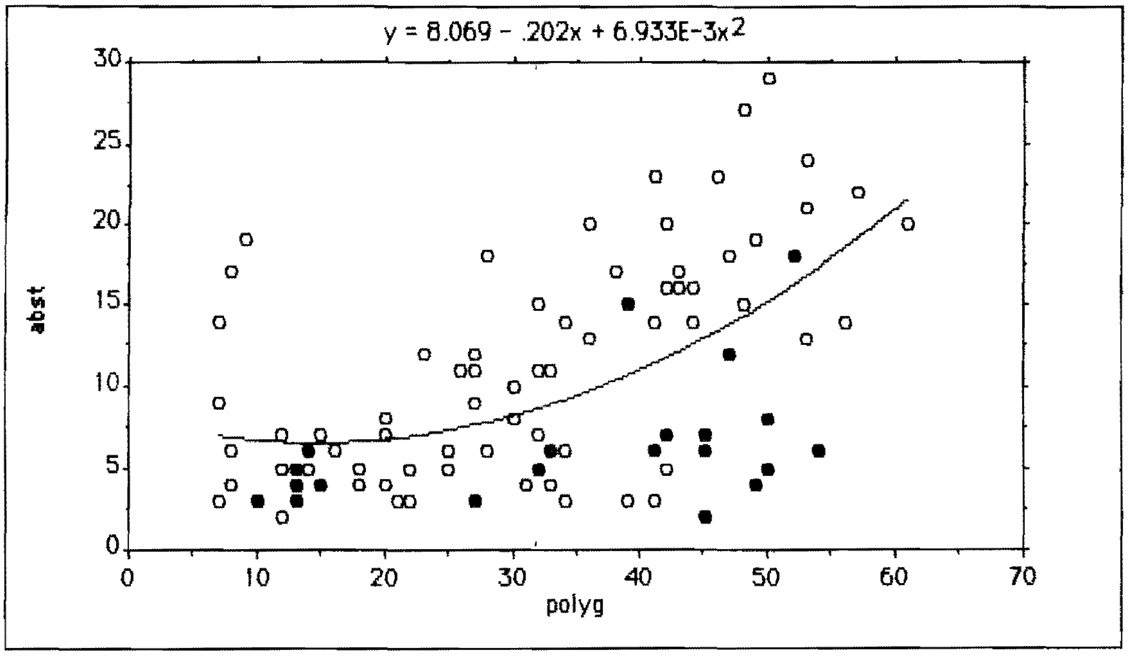


Figure 11: Relationship between the average duration of postpartum abstinence and the percentage of married women 15-49 in polygynous unions; WFS + DHS regions in sub-Saharan Africa.

● areas with more than 75 percent of women Islamic
o other areas

polynomial r = 0.55

WFS+DHS : Pp. non-susc. period with mean yrs. of educ. N=92

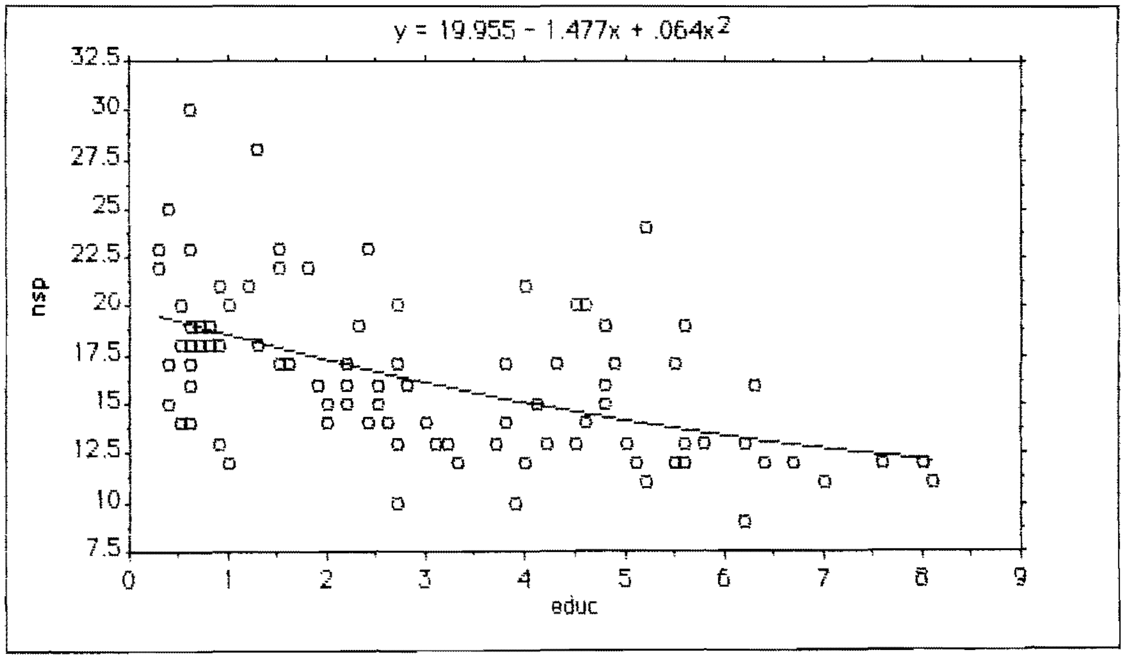


Figure 12: Relationship between the length of the overall postpartum non-susceptible period in months and the mean number of years of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.53

WFS+DHS : % desired fam.size LE 4 with mean yrs of educ women. N=92

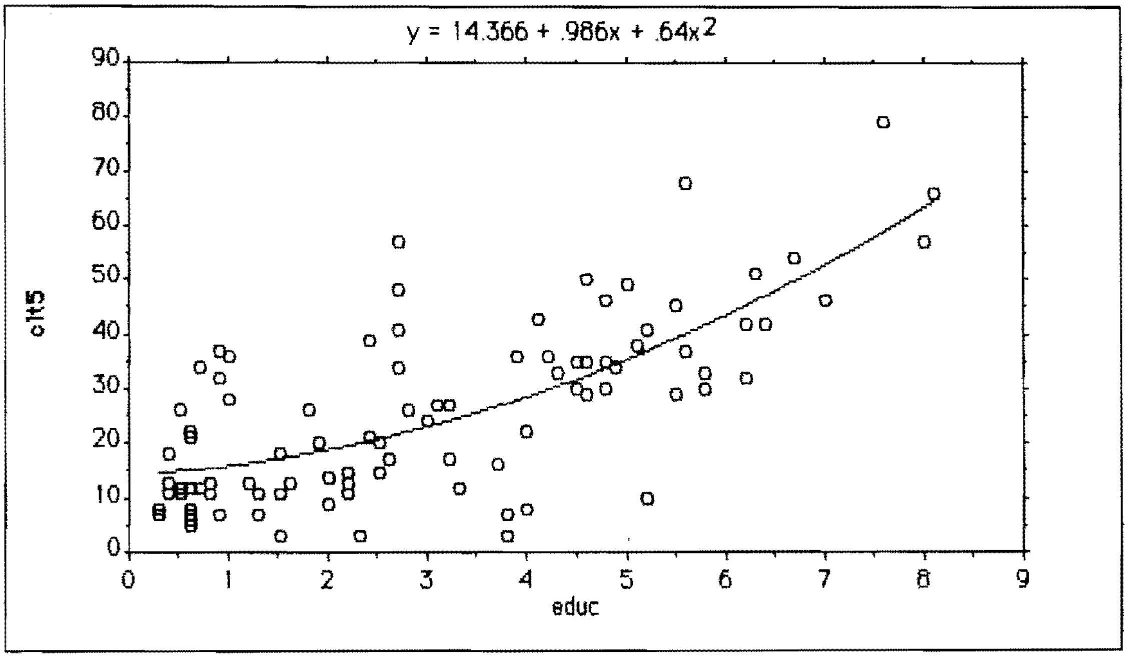


Figure 13: Relationship between the percentage of currently married women 15-49 with desired family sizes of 4 children or less and the mean number of years of female schooling; WFS + DHS regions of sub-Saharan Africa.

polynomial r = 0.73

WFS+DHS : % knowing at least of 1 modern method and mean yrs educ. women N=92

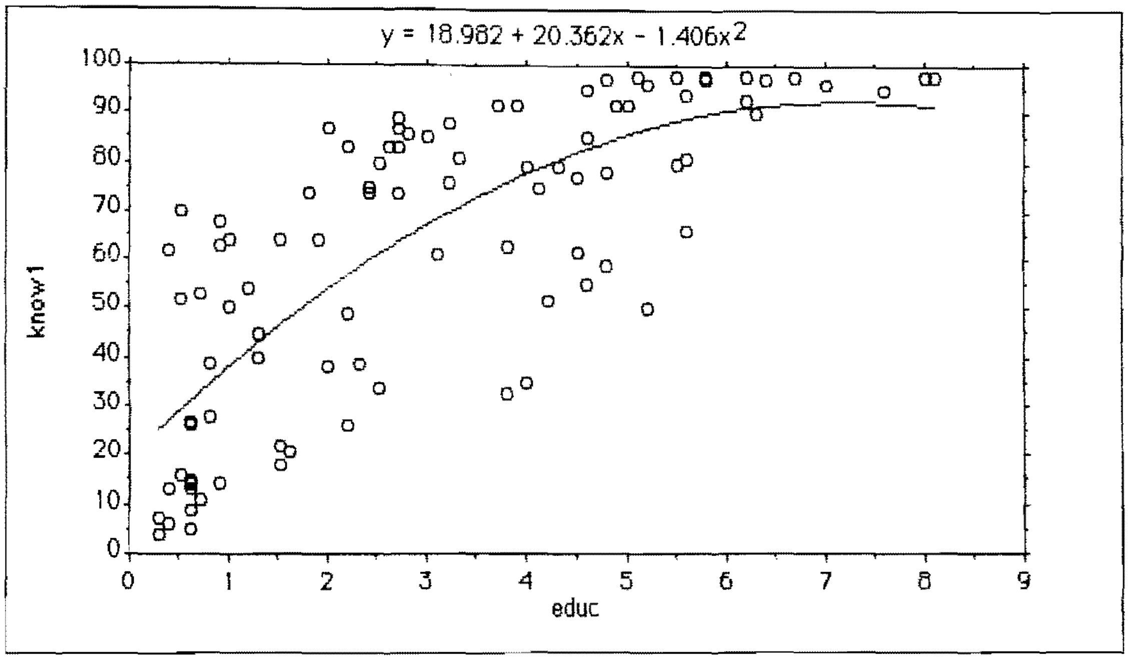


Figure 14: Relationship between the percentage of women 15-49 knowing at least one modern method of contraception and the mean number of years of female schooling; WFS + DHS regions of sub-Saharan Africa.

polynomial r = 0.77

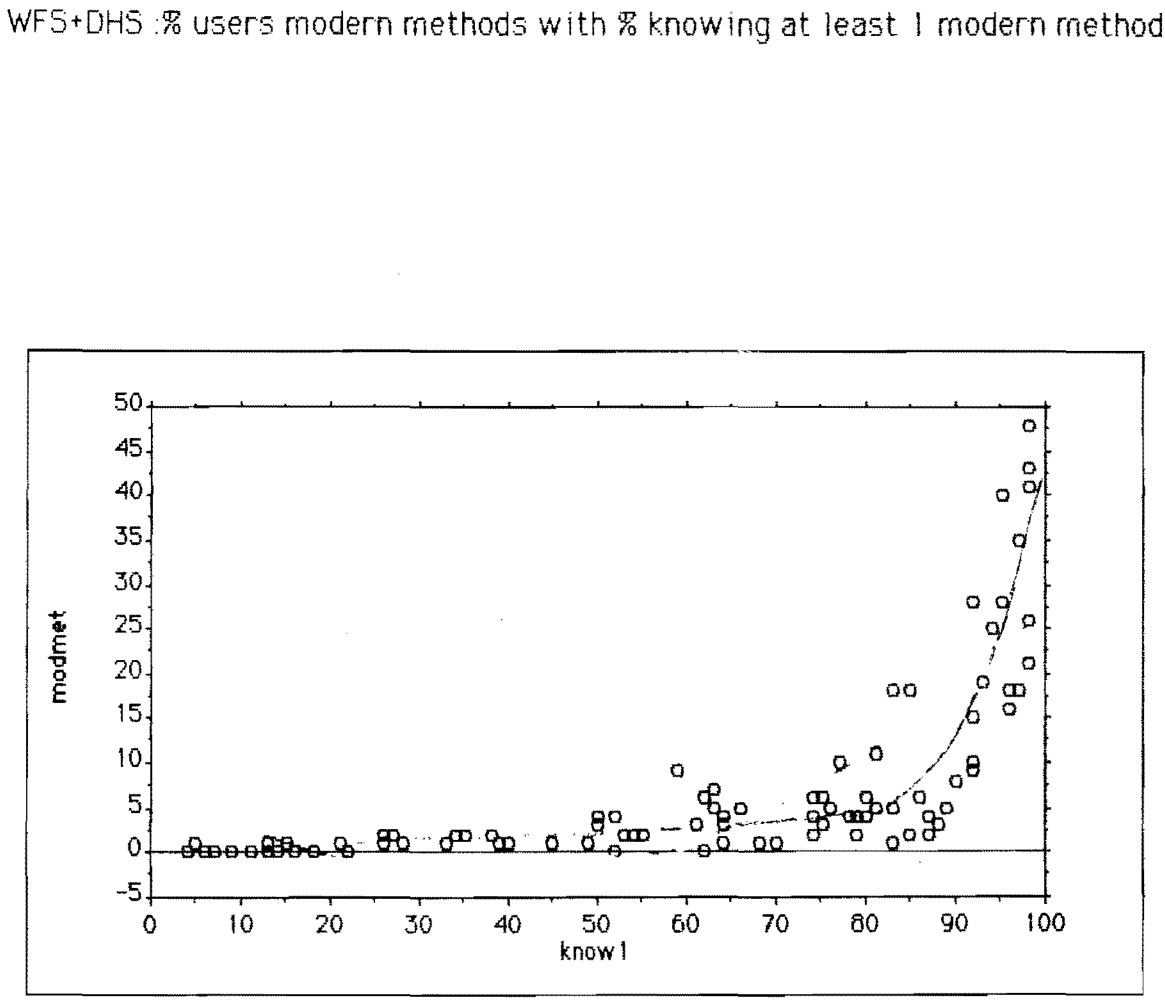


Figure 15: Relationship between the percentage of currently married women 15-49 using modern methods of contraception and the percentage of all women knowing of at least one modern method; WFS + DHS regions of sub-Saharan Africa.

polynomial r = 0.80

WFS+DHS :% users modern methods with mean years education

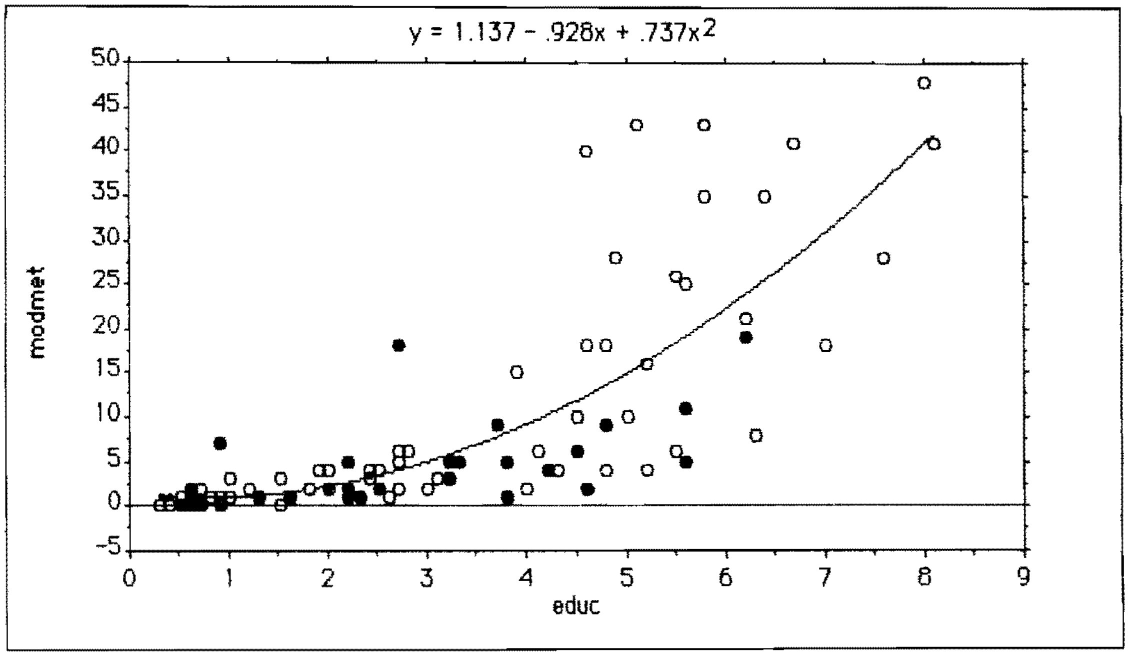


Figure 16: Relationship between the percentage of currently married women 15-49 using modern methods of contraception and the mean number of years of female schooling; WFS + DHS regions of sub-Saharan Africa.

● : WFS
o : DHS

polynomial r = 0.80

WFS+DHS : % users modern meth. with mean yrs of educ women. N=92

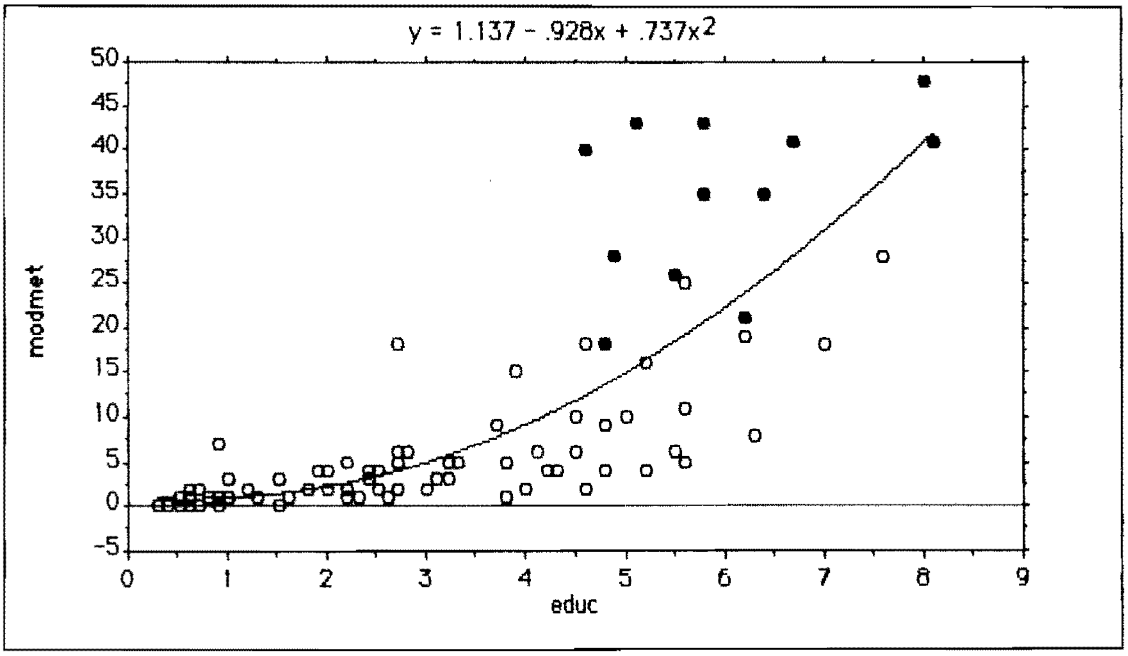


Figure 17: Relationship between the percentage of currently married women using modern methods and the mean years of education; WFS + DHS regions in sub-Saharan Africa.

● = regions of Zimbabwe and Botswana (DHS)
o = other regions

polynomial r = 0.80

WFS+DHS :% users modern methods with mean years education

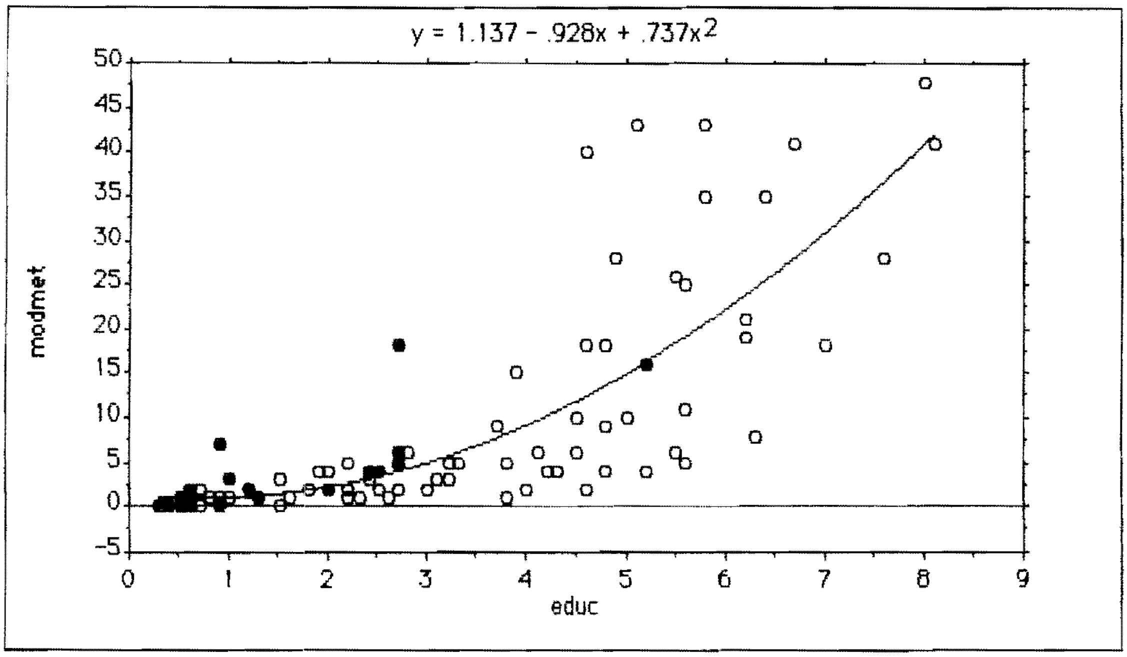


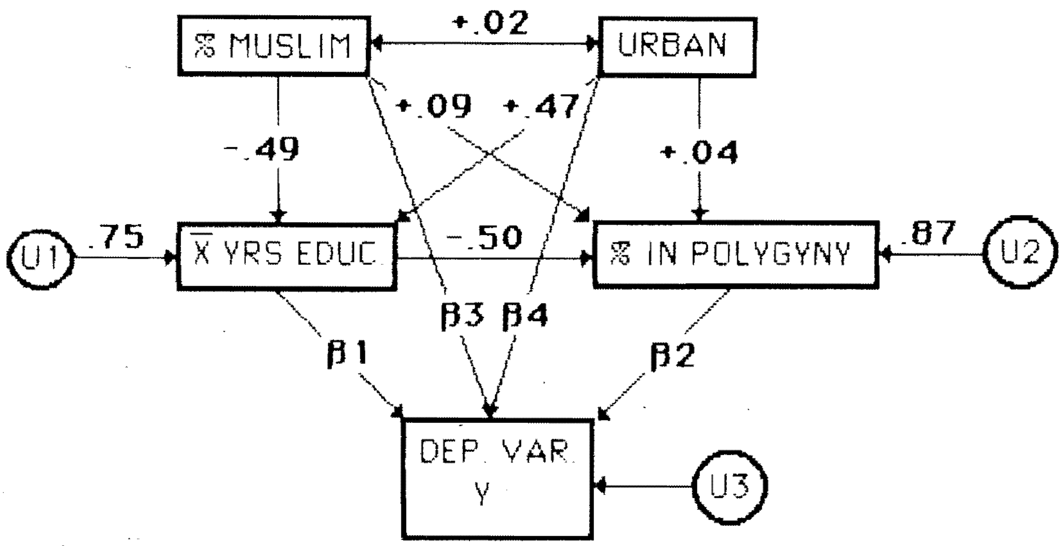
Figure 18: Relationship between the percentage of currently married women using modern methods and the mean years of female education; WFS and DHS regions in sub-Saharan Africa.

● areas with more than 75 percent of Islamic women
o other areas

polynomial r = 0.80

FIGURE 19

REGRESSION MODEL FOR VARIOUS DEMOGRAPHIC DEPENDENT VARIABLES - DHS REGIONS, N=55



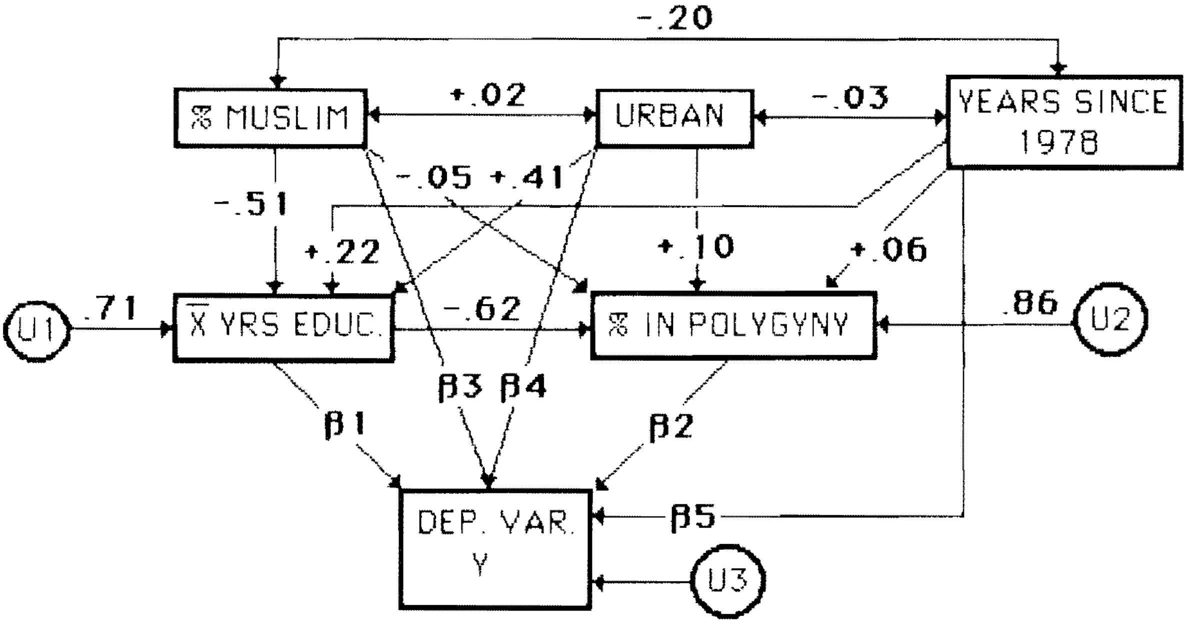
DEP. VAR. Y	β1	β2	β3	β4	R^2_{adj}	U3
% SINGLE 15-19	-.03	-.33**	-.58**	+.16	.63	.61
X̄ BREASTFEEDING	-.72**	+.02	-.26*	-.14	.50	.71
X̄ AMENORRHEA	-.82**	-.08	-.11	-.09	.59	.64
X̄ PP. ABSTINENCE	+.07	+.71**	-.23	-.02	.38	.79
X̄ PP. NON-SUSCEPT.	-.60**	+.29*	-.26*	-.04	.49	.71
% DES. FAM. SIZE LE 4	+.39**	-.13	-.26*	+.32**	.61	.62
% KNOW 1+ MOD. METH.	+.62**	-.09	-.15	+.04	.56	.66
CONTRAC. USE-EFF.	+.72**	-.24*	-.01	-.09	.67	.57
% USERS MOD. METH	+.71**	-.27**	+.04	-.10	.65	.59

* sign. at .05 ** sign. at .01

N=51 for analysis of % single due to missing values for 4 regions of Northern Sudan.

FIGURE 20

REGRESSION MODEL FOR VARIOUS DEMOGRAPHIC DEPENDENT VARIABLES - WFS+DHS REGIONS N=92

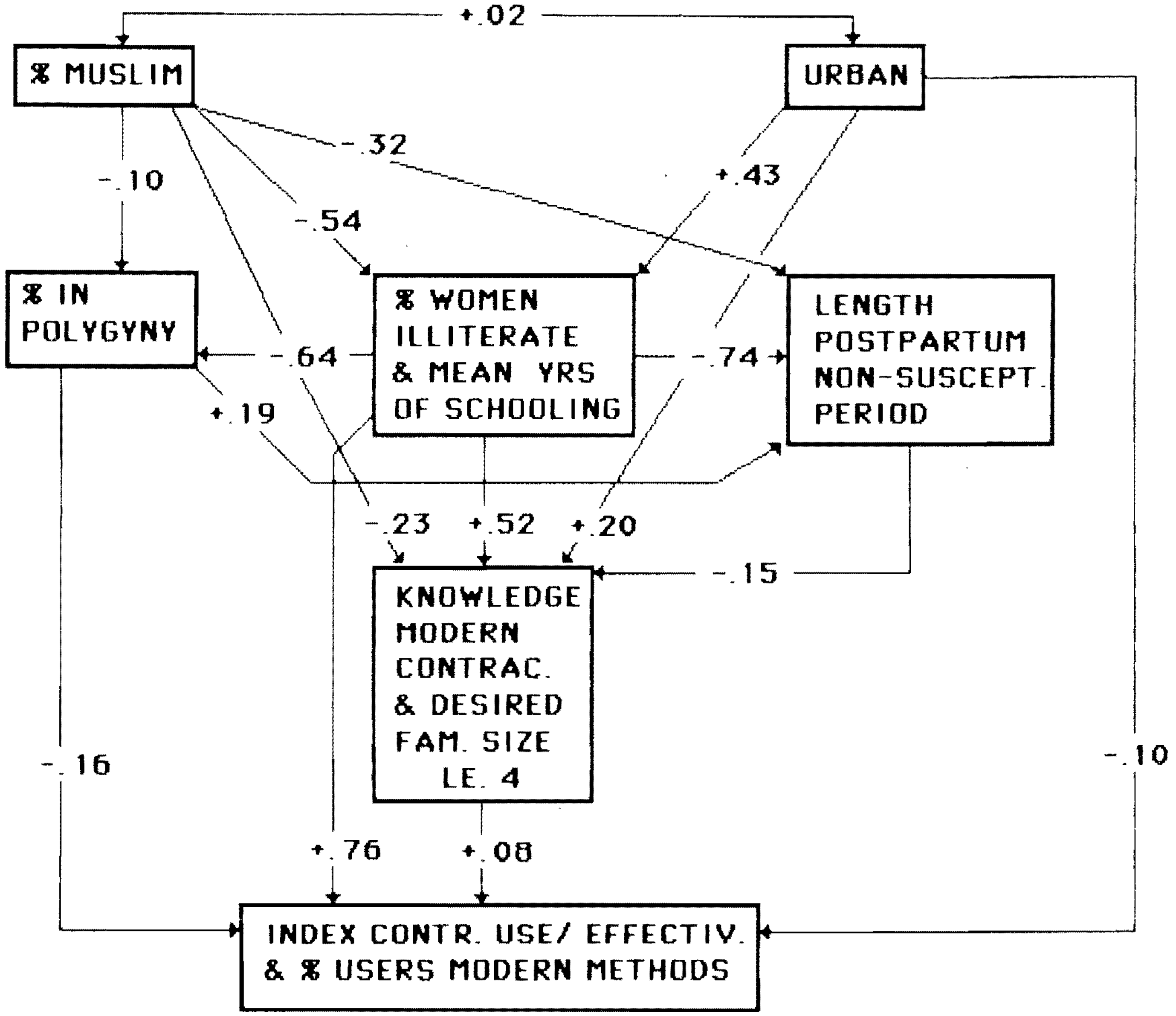


DEP. VAR. Y	β1	β2	β3	β4	β5	R^2_{adj}	U3
% SINGLE 15-19	+.07	-.44**	-.34**	+.14	+.12	.57	.65
X̄ BREASTFEEDING	-.60**	+.12	-.26*	-.15	+.19*	.38	.79
X̄ AMENORRHEA	-.68**	+.06	-.13	-.20*	+.29**	.54	.68
X̄ PP. ABSTINENCE	-.10	+.54**	-.36**	-.00	-.12	.32	.82
X̄ PP. NON-SUSCEPT.	-.54**	+.32**	-.33**	-.08	+.10	.43	.75
% DES. FAM. SIZE LE 4	+.42**	-.24**	+.01	+.15*	+.34**	.61	.62
% KNOW 1+ MOD. METH.	+.54**	-.20**	-.03	-.04	+.29**	.64	.60
CONTRAC. USE-EFF.	+.62**	-.22**	+.07	-.06	+.27**	.66	.59
% USERS MOD. METH.	+.65**	-.25**	+.12	-.06	+.16*	.62	.62

* sign. at .05 ** sign. at .01
N=88 for analysis of % single due to missing values for 4 regions of Northern Sudan.

FIGURE 21

CONTRACEPTIVE USE SUB-SAHARAN AFRICA --LISREL MODEL FOR THE 55 DHS-REGIONS.



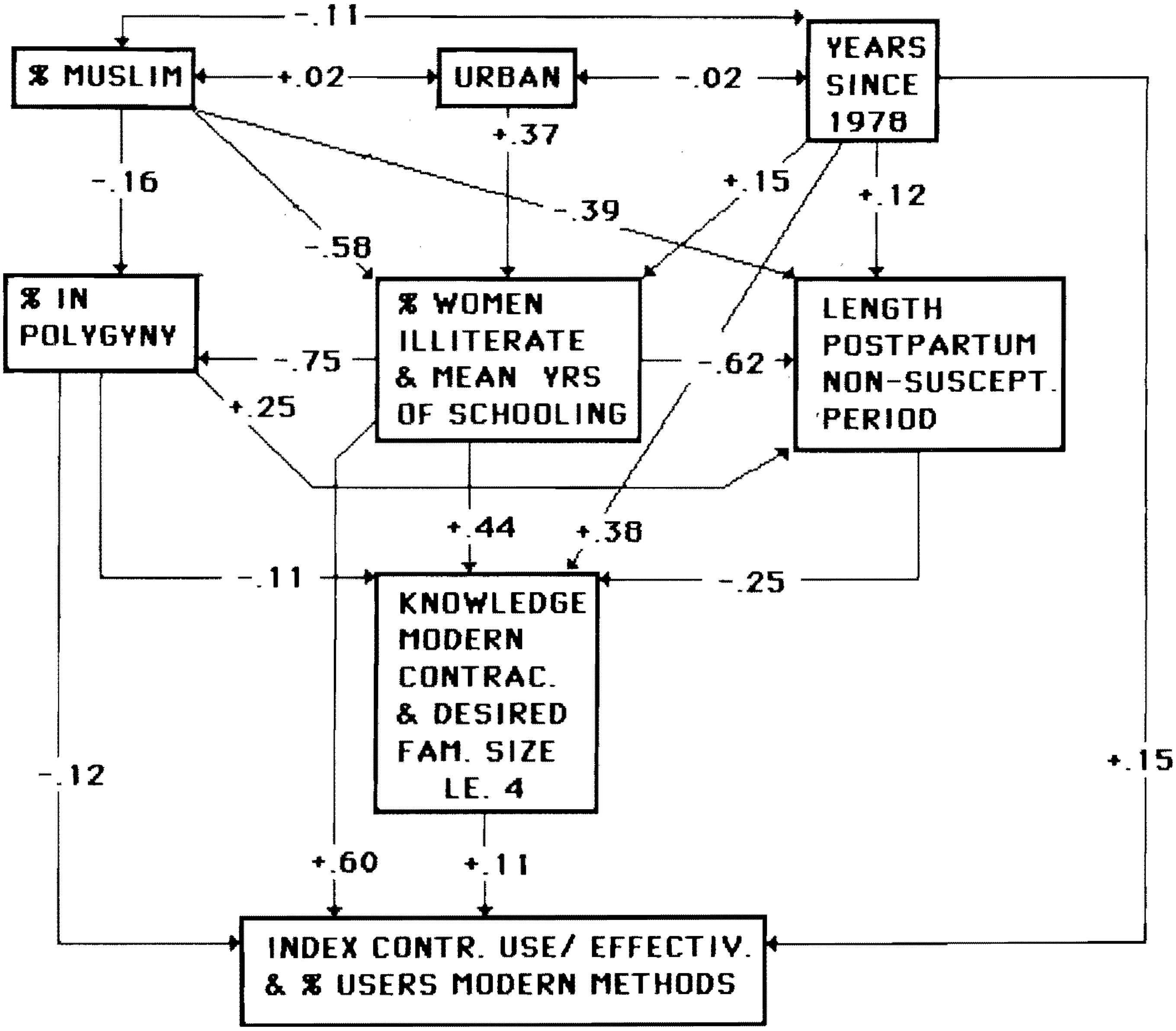
DEP. VAR	R^2
POLYG.	.37
LITERACY	.46
NON SUSC.	.58
KNOWL & DES. FAM. S.	.76
CONTR. USE	.71

ADJ. GOODNESS OF FIT = .987
ROOT MEAN SQUARE RESIDUAL =.053

VERLEYE, LESTHAEGHE & JOLLY 1992

FIGURE 22

CONTRACEPTIVE USE SUB-SAHARAN AFRICA --LISREL MODEL FOR THE POOLED WFS REGIONS (N=37) AND THE DHS REGIONS (N=55)



DEP. VAR	R^2
POLYG.	.39
LITERACY	.51
NON SUSC.	.49
KNOWL & DES. FAM. S.	.79
CONTR. USE	.64

ADJ. GOODNESS OF FIT = .989
ROOT MEAN SQUARE RESIDUAL =.043

VERLEYE, LESTHAEGHE & JOLLY 1992

WFS+DHS : 1000*(log Ci+log Cc) with 1000*(logCi-logCc). N=92

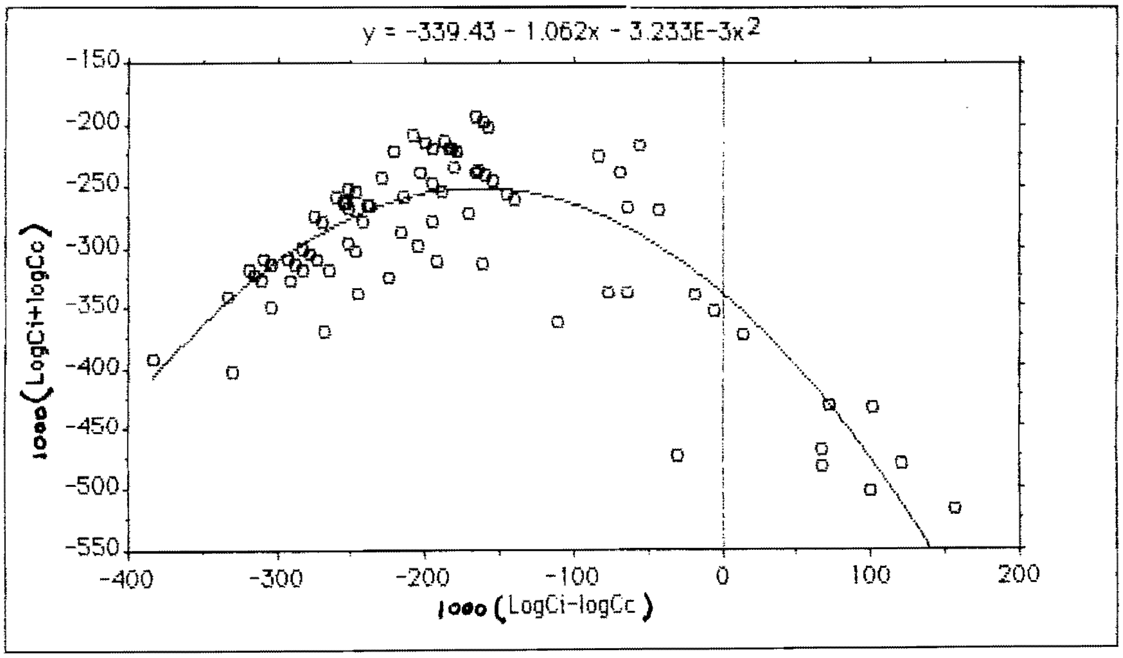


Figure 23: Relationship between the total degree of fertility reduction (vertical axis) and the difference between the shares of postpartum non-susceptibility and of contraception; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.86

WFS+DHS : 1000*(log Ci+log Cc) with mean female educ. N=92

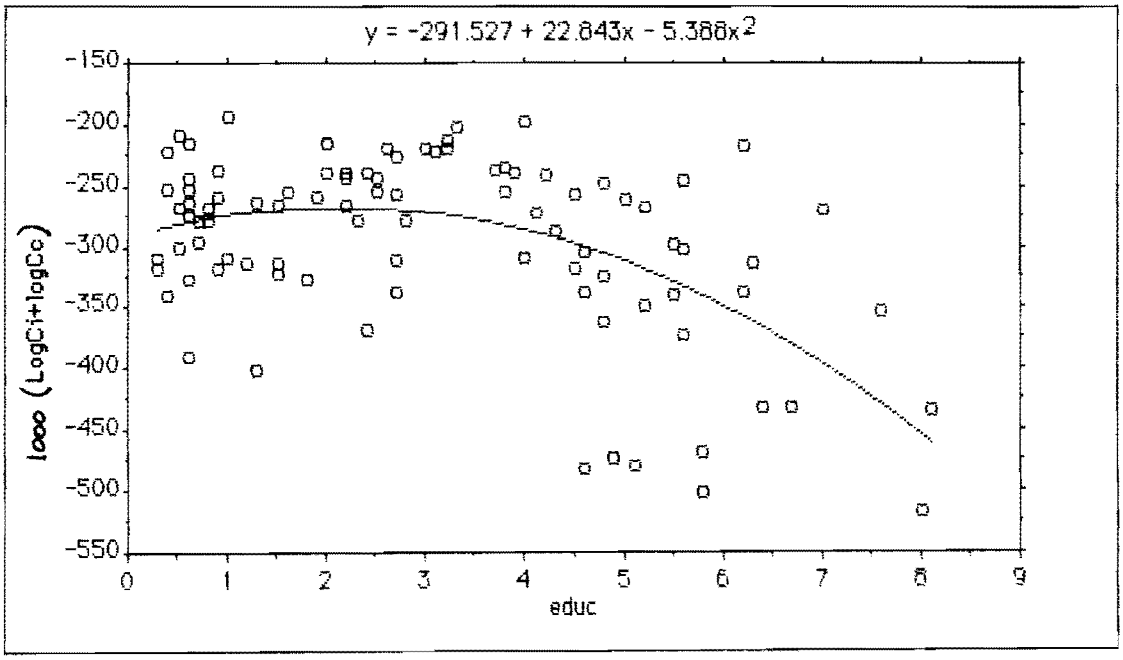


Figure 24: Relationship between the joint fertility reducing effects of postpartum non-susceptibility and of contraception, and the average length of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.54

WFS+DHS : 1000*(log Ci-log Cc) with mean female educ. N=92

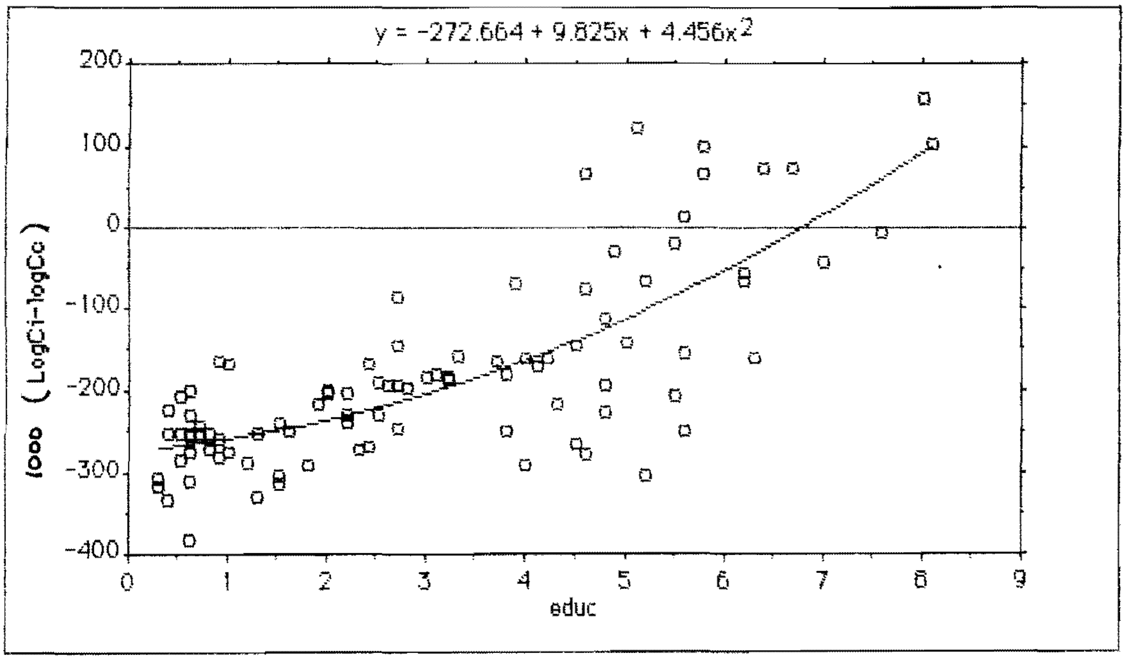


Figure 25: Relationship between the growing impact of fertility reduction via contraception over postpartum non-susceptibility, and the average length of female schooling; WFS + DHS regions in sub-Saharan Africa.

polynomial r = 0.77