THE TIMING OF HUMAN MENARCHE

By

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ABSTRACT

Like other aspects of female physiology, menarche is sensitive to aspects of the social and physical environment. Two surveys, involving 1,314 Ontario residents, were distributed to examine the relationship between family composition and the timing of human menarche. The average menarcheal age was 13.00 years and is concordant with previous estimates for central Canada. Menarche occurred most frequently in the spring and summer months and occurred later in women born after 1960 than in those born prior to this date. Most socioeconomic factors did not significantly influence the timing of menarche. Height and weight were not independently related to the timing of menarche, but weight per height was marginally and negatively correlated with menarcheal age. Total score on a life events inventory, a measure of stress, was negatively and significantly correlated with the age at menarche. Menarcheal age was positively related to the age at which a girl began dating. The most striking finding was that girls who experienced father absence before menarche matured on average 4.5 months earlier than girls who lived with both parents continuously. Moreover, girls who had experienced father absence before ten years of age and because of divorce matured 5-6 months earlier than girls growing up with both parents. Absence of the mother and number of brothers and sisters did not appear to be related to the timing of menarche. A significant correlation existed between mothers' and daughters' ages at menarche. The mothers of father-absent girls tended to be early maturers, dated early, had early first births and reported more negative views of men than did the mothers of father-present girls. Heredity and psychological stress may largely account for the early age at menarche observed in father-absent girls, but physical exposure to a father and other psychological factors could also be involved.

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CHAPTER 1. PERSPECTIVES ON HUMAN MENARCHE

Menarche is an important milestone in women's lives. Often a subject of ritual and taboo, first menses is a discrete signal of impending fertility. Like other aspects of human development, the timing of menarche has been shaped by a history of natural selection. At menarche, physiological, psychological and behavioural changes reflect a female's changing role and interests as she moves into the adult phase of life. Morphological changes, including the reorganization of hormonal systems, are the most obvious of the developmental changes at menarche. However, a wealth of research demonstrates that substantial psychological and behavioural transitions also take place at menarche. These include the reorganization of self-image and changing social relationships with peers and family members.

There is considerable variability in the timing of menarche both across and within populations. The Bundi of New Guinea are recorded to have one of the latest average ages of menarche; 18.0 years, while affluent Hong Kong girls attain menarche at 12.4 years on average (Low, Kung & Leong, 1982; Malcolm, 1970). It is clear that the sources of variation in human menarcheal age are both hereditary and environmental, although many suggested sources of environmental variation have yet to be confirmed (Table 1). Numerous reports of significant concordance in the age at menarche between female relatives are considered to be strong evidence for the influence of hereditary factors (see Tanner, 1962). Moreover, extremely early puberty, not attributed to a known dysfunction, referred to as "constitutional" or "familial" precocious puberty, tends to run in families (Novak, 1944). Perhaps one of the most famous examples of precocious puberty is the South American girl, Lina Medina, who had her first menstrual period at less than one year of age, became pregnant just before her fifth

Table 1. Influences on the timing of human menarche

Hereditary influences	(examples)
Concordance between female relatives	Damon, Damon, Reed & Valadian, 1968; Fischbein, 1977; Poponoe, 1928; Kantero & Widholm, 1971; Tisserand-Perrier, 1953.
Environmental influences	
(well-documented)	
Socioeconomic class	Aw & Tye, 1970; Lee, Chang & Chen, 1963; Eveleth & Tanner, 1976
Family size	Jenicek & Demirjian, 1974; Stukovsky, Valsik & Bulaistirbu, 1967; Valsik, 1965
Urbanization	Eveleth & Tanner, 1976 (review)
Annual light cycles	Cagas & Riley, 1970; Kantero & Widholm, 1971; Reymert & Jost, 1947; Valsik, 1965;
(suggested, little empirical evidence)	
Psychosexual stimulation	Adams, 1981; Brown, 1966
Family composition	Barkow, 1984; Burger & Gochfeld, 1985; Jones, Leeton, McLeod & Wood, 1972
Stress	Adams, 1981; Whiting, 1965

birthday and gave birth at 5.5 years of age (Escomel, 1939, cited in Dewhurst, 1984).

Conditions in the physical and social environment also influence human menarche. Annual light cycles are known to influence human fertility as well as the occurrence of menarche (reviewed by Cowgill, 1966; Valsik, 1965) and socioenvironmental influences on the age at menarche, such as socioeconomic status, family size, urbanization and birth order have been demonstrated in a variety of human populations (reviewed by Eveleth & Tanner, 1976). A few authors have suggested that other factors in the social environment, such as psychosexual stimulation, exposure to conspecifics and "stress" may also influence the menarche (e.g. Brown, 1966; Adams, 1981), but little empirical investigation of these hypotheses has been undertaken.

One thing that is striking about many previous studies is how little of the variance in menarcheal age is accounted for by the variables under examination. For example, Roberts and Dann (1967) found that entering the relevant socioenvironmental variables into a regression analysis accounted for only 7% of the variance in menarcheal age. In this regard, we have not been very successful in identifying the sources of variation in human menarche. Furthermore, theory in this area has developed even less. Not only have we not identified the sources of variation but we do not understand why such huge variation exists or whether it has any functional significance in the life history of our species. The adoption by human developmentalists of a broader perspective, which considers the timing of human development in a comparative framework informed by a modern view of natural selection (e.g. MacDonald, 1988; Smith, 1987; Weisfeld & Billings, 1988) may be useful in identifying the sources of variation in the timing of human menarche.

The main purpose of this research was to explore the relationship between family composition and the timing of human menarche in a sample of Ontario women. Before this task

could be completed, however, it was necessary to examine the relationship of menarche with other factors in the social and physical environment known to influence its timing. This research was initially inspired by knowledge of the existing literature on non-human development and was motivated by the desire to place the study of human menarche into a broader perspective.

Menarche in a life historical perspective

Traditional theories of development tend to view the adult stage as the ultimate goal of development. In contrast, an evolutionary life history approach suggests that selection operates on all stages in the lifespan, not just the adult form. Natural selection produces a species typical life history or ontogeny consisting of a series of stages, all of which are adapted to the environmental and social circumstances encountered at that point in the lifespan (although such stage-specific adaptations may be constrained by the demands of other life stages). For example, selection has influenced the timing and nature of various reproductive events, setting boundaries and constraints on their occurrence based on their fitness effects. Typical questions solved in the life history of a species include when to reproduce, how often to reproduce, how many offspring to produce and how much to invest in each offspring (Stearns, 1976).

All organisms access finite resources which they allocate to growth, maintenance or reproduction (Calow & Townsend, 1981). Allocating what resources to what function is the basic problem resolved within the life history of a particular species. Thus the life history approach considers the changing pattern of resource allocation throughout an organism's entire lifespan as the focus of selection pressures. Insofar as they invest differing amounts of energy into reproduction, females and males may be expected to exhibit different life histories (Trivers, 1972). For instance, female mammals invest more energetically in offspring than

males, and their smaller body size in many species reflects the trade-off between reproduction and growth. Females of many species reach adult size and reproductive maturity sooner than males (Tanner, 1962), a phenomenon known as sexual bimaturism. In species where reproductive competition between males is intense and where reproductive success is dependent on size, males may benefit from growing to a larger size and delaying reproduction until they are able to compete (LeBoeuf, 1974 ; Wittenberger, 1979).

Human sexual bimaturism and dimorphism

Humans exhibit sexual dimorphism in size, fat storage, maturation rates and in length of the reproductive lifespan. Human males are generally larger than females and tend to go through the growth spurt and adolescence a couple of years later than females (Tanner, 1962). Perhaps one of the most striking sex differences, which becomes apparent at puberty, is the percentage of body fat (Lancaster, 1986). Females allocate more energy to fat storage for use later in reproduction, compared to males. From menarche to 18 years of age girls gain an average of 4.5 kilograms of fat. The total deposition of fat at the end of this time is 16 kg, which represents enough stored energy (144,000 calories) for gestation and three months' lactation (Frisch & McArthur, 1974). This results in a girl's body composition increasing from 16% body fat at the beginning of the adolescent growth spurt to 28% at the attainment of stable reproductive ability at 18 years of age (Frisch, 1975). In contrast, males at puberty tend to increase the amount of muscle tissue, particularly in the chest and shoulder area (Winick, 1981). At the end of puberty a male 180 cm tall will have on average 9 kg of fat, while a women of the same height will have 20 kg (Winick, 1981).

Females have evolved physiological mechanisms that enable them to efficiently store fat. Women have less muscle tissue than men, and because it is the action of muscles which burns

fat, this makes it more difficult for women to lose weight compared to men. Mechanisms which alter metabolic pathways, leading to increased fat storage rather than muscle production, may be viewed as adaptations to the great energetic demands of childbearing under conditions of food shortage (Hoyenga & Hoyenga, 1982). In this sense, the fat accumulated at the end of puberty has been aptly termed "reproductive fat" (Lancaster, 1986).

Fat storage is particularly important in mammalian species in which young depend on lactation and females must act as a buffer between offspring demands and the availability of food. After birth, energy and other nutrients are often directed into the production of milk at the expense of the mother's own body supplies. For example, the breast milk of undernourished women does not differ in caloric or protein content from that produced by well-nourished women (Frisch, 1975). Thus nursing ability is not tied directly to food resources but to the differential allocation of energy and nutrients within the mother during lactation.

Another sexually dimorphic characteristic of human males and females is that female fecundity ends abruptly at menopause, whereas males may continue to function reproductively until death. A post-reproductive period such as this is uncommon in most species. Whether menopause is a feature common to all primates is not known because, in general, primates rarely survive until menopause can be documented. However, reports of post-reproductive primate females living in the wild (e.g. Waser, 1978) and rhesus macaques exhibiting menopause in captivity (van Wagenen, 1972) suggest that menopause may occur in other primate species.

It has been suggested that menopause is merely the result of general senescence (Graham, 1981). Menopause may be the by-product of our artificially prolonged life span and may have no selective advantage. If this were true then we might expect that factors that contribute to an early senescence might also contribute an an early menopause. Similarly if

early maturity were indicative of a faster rate of development we might expect early menarche to be correlated with early menopause.

Williams (1957) suggested that selection could favour the continued survival of post-reproductive individuals where parental care contributes to the survival and fitness of offspring. Gaulin (1980) has extended this argument to account for sex differences by suggesting that where parental investment is skewed toward female investment and where continued parental investment may enhance the reproductive success of offspring, a postreproductive period may be adaptive for females, but not males. In an initial test of this hypothesis, Mayer (1982) examined the fertility of 1,890 women and found that those who died postmenopausally had greater inclusive fitness than those who died premenopausally. Therefore, menopause may represent a point in a woman's lifespan at which the energetic expenditures, depletion of mineral reserves and risk of mortality of having another child are exorbitant and she is better off ceasing reproduction and investing in existing offspring.

Life histories of female hunter-gatherers

It has been argued that modern human societies provide little insight into the basic female life history, because technology has significantly changed women's roles and has resulted in the use of artificial devices to alter fertility and birth spacing (see Alexander, 1979; Lancaster, 1986; Symons, 1979). For example, Symons (1979) has argued that fitness maximizing behaviours in modern environments should be considered adaptive only if there is reason to believe that these traits had similar effects in the prototypical environment in which most of human evolution occurred. The belief that the relatively "novel" environment of industrial society is a poor place to study human adaptation is usually coupled with the idea that it is necessary to reconstruct a hunting-gathering scenario to understand the evolutionary

forces that selected for female reproductive physiology and behaviour.

Information from modern hunter-gatherers, the Kalahari !Kung, has been used to reconstruct the environment of the human female typical through over 99% of our evolutionary history. The typical !Kung woman attains menarche at a relatively late age (16.60 years) followed by a long period of adolescent subfertility of approximately two to three years. On average she first gives birth at 19.94 years of age and nurses the child continuously for several years. The resulting lactational amenorrhea keeps births spaced approximately four years apart. This long birth spacing coupled with a fairly early decline in fecundity (35.5 was the average age of last birth) results in an average completed fertility of 5 children. Due to infectious diseases, only 2 or 3 of these children usually survive (Howell, 1979).

Compared to traditional !Kung women, women in agricultural and industrial societies experience a relatively early menarche, due partly to improved nutrition and a more sedentary lifestyle. The !Kung lead an active life, travelling far to gather food and hunt. They live a marginal existence compared to other peoples and the women, while not malnourished, are lean compared to North American women (Howell, 1979). Medical advances in modern industrialized countries have reduced the rates of maternal and infant mortality making it possible for modern women to have very high completed fertility. Use of contraceptives and abortion in modern times have replaced the long periods of lactational amennorrhea which served as a method of birth spacing and of reducing the number of pregnancies in hunter-gatherers. As a result, women in industrial society experience nine times the number of menstrual cycles as the !Kung (Short, 1976). Some of the problems associated with increased menstrual cycling and delayed and few pregnancies which afflict modern women, such as dysmenorrhea, premenstrual tension and breast cancer would not have been so prominent in early human civilizations. Moreover teenage pregnancy and the bearing of children before social

and psychological competence was achieved by the mother would be very unlikely events.

Menarche among the primates

While human menarche shares some features with menarche in other primate species, it is also unique in certain respects. Like other primates, humans go through puberty relatively late compared to other mammals of equal body size. Non-human primate females attain menarche anywhere from one year of age (mouse lemur) to 13 years (chimpanzees) (Jolly, 1985). Sexual bimaturism, with males maturing approximately two years later than females but attaining fertility at an earlier stage is also a common feature of primate life histories.

The adolescent growth spurt is a unique feature of primate development and is especially prominent in human males and females (Tanner, 1962). A growth spurt of much smaller magnitude is apparent in our closest relatives, the chimpanzees, and is almost undetectable in rhesus macaques (Watts & Gavan, 1982). The location of menarche within this spurt differs appreciably among primate species. For example, menarche is typically late in the sequence of human pubertal events, occurring after the appearance of most other secondary sex characteristics and the growth spurt. In general human females have attained 70% of their adult stature at menarche, chimpanzees 80% and rhesus macaques, 30% (Gavan & Swindler, 1966; Watts & Gavan, 1982). The concomitant "fat spurt" which occurs in human females with the deposition of fat on the breasts and buttocks is not typical of other female primates. Low, Alexander and Noonan (1987) suggest that such accumulations of fat in human females may represent deceptive sexual signals which mimic other indications of high reproductive value and potential.

In many female primates a long period of sub-fertility follows the menarche (Montagu, 1979). In humans a large percentage of menstrual cycles in the first few years following

menarche are anovulatory and high proportions of ovulatory cycles do not occur until the early twenties. Israel (1967) suggested that anovulatory cycles in young women were "the rule rather the exception". Vollman (1966) found that 45% of menstrual cycles in the first year following menarche were anovulatory. The proportion of ovulatory cycles, as inferred from basal body temperature charts, increased as a function of a women's age but the maximum number of ovulatory cycles (97%) was not achieved until women reached the average age of 23.

Lunenfeld and colleagues (1986) have claimed adolescent sterility is the by-product of the fact that different components of the reproductive system mature at different rates or that reproductive function becomes "primed" in the few years following menarche before maximum fecundity is achieved. Another possible interpretation is that post-menarcheal sterility has evolved in response to certain selection pressures. Sterility following first menses provides a young woman with a period of psychological and social adjustment, during which she can prepare herself socially and emotionally for her first pregnancy. It also permits sexual experimentation with a variety of partners or trial marriages, which may increase the probability of finding a high-quality suitable mate.

Significance of the growth and fat spurt in human females

The human infant is helpless at birth and possesses an immature brain less than 25% of adult size. At one time it was thought that the reduced size of the human pelvis, as an adaptation to bipedalism, led to the production of altricial young in Homo sapiens. The size and maturity of the human infant were presumed to be restricted by the size of the birth canal. This hypothesis, however, could not explain why great apes also produce young in whom a majority of brain growth and development occurs after birth, even though they have a pelvic capacity which far

exceeds the necessary size for a safe delivery (Lancaster, 1986). Mason (1968) suggested that human and great ape babies are altricial as an adaptation to a social learning environment typical of primate life. Continuing postnatal neural growth and plasticity facilitates the learning of social skills and the assimilation of ecological contingencies. Therefore, bipedalism may not have constrained the maturity of the infant at birth. Rather human infants may have evolved in such a way that most brain growth occurs outside the womb and is open to learning and social influences.

It is quite common for many mammalian females to continue to grow after puberty and even after the birth and weaning of their first litter. In species where females continue to grow after fertility is achieved there may be a conflict between maternal weight gain and fetal growth and lactation. A female who attains adult size and has a store of energy supplies before first pregnancy has more energy to devote to gestation and lactation. Lancaster (1986) suggests that the selection pressure for increased fat storage among human females at menarche is the energy demand of the developing human brain which grows 75% of its total size in the first few years after birth. Fat storage in human females allows for long periods of lactation and high quality milk, without a concomitant decrement in the mother's growth and health. Therefore the adolescent fat spurt sustains the production of altricial young with large cortices who are dependent on their parents for care as well as the imparting of social and survival skills.

Another function of the "fat" or pubertal growth spurt in human females is that it serves not just as a physical gauge of the general condition of the female but also as a signal of her social and psychological status. In humans, physical condition and the amount of body fat can be influenced by social status or socioeconomic factors as well as by psychological states. For example a girl whose family has accrued many resources or who has established a food sharing network of relatives and friends, will tend to have greater fat deposits and earlier menarche. On

the other hand, girls who are under considerable psychological stress may have low body fat. Therefore the amount of fat accumulated in the period immediately after puberty, which is necessary for the sustenance of a pregnancy and lactation, reflects a girl's psychological and social condition as well as her physical condition.

Parent-offspring conflict at adolescence and parental manipulation of girls' reproduction

Adolescence is a time of turmoil for both children and parents. Why is it that the parent-child relationship goes from being one of mutual affection to one of outright conflict? It may be useful to think about the problems encountered at adolescence by borrowing the concept of "parent-offspring conflict" from evolutionary biology (Trivers, 1974). Insofar as they are not genetically identical, the reproductive interests of parents and offspring may diverge. Parents have evolved to invest in each of their children in a manner so as to maximize their own inclusive fitness, while each offspring has evolved to value their own fitness above that of their siblings and therefore to strive for more than their share of parental investment. When children are young and dependent, the conflict is not a symmetrical one and children's interests are necessarily subservient to those of their parents (Alexander, 1974).

However, parent-offspring conflict emerges in a different form at adolescence, as children become reproductively mature and capable of independent existence. At adolescence, parents may continue to view their children as vehicles of their own inclusive fitness and may direct them into activities and behaviours that improve their own inclusive fitness, at the expense of their children's fitness, a phenomenon referred to as parental manipulation (Alexander, 1974).

For example, Turke (1988) found that among the residents of a Micronesian atoll

(Ifaluk) women who bore a daughter first achieved higher reproductive success than women whose first children were male. Turke suggested that the higher reproductive success of women who first bore daughters was related to the help that daughters provided in the raising of other offspring. Moreover, daughters who had the greatest number of siblings (or who provided the most help) had a lower fertility than daughters with fewer siblings. Similarly, Flinn (1988a) found that the assistance of adolescent daughters in childraising enabled a mother to produce and raise more offspring than otherwise possible, but resulted in delayed entry into reproduction on the part of the daughter. In contrast, a post-menopausal mother may not be able to increase her own reproductive success through manipulating her daughter but may be more interested in helping her daughter produce and nurture grandchildren. The presence and aid of a grandmother may be beneficial to a woman, especially when she is lacking the support of a male.

A mother's conflicts with her daughter may derive from a different set of interests than a father's. A mother, especially a post-menopausal mother, cannot improve her reproductive success by buying more husbands, but she can increase it by enlisting the aid of her daughters or by investing in grandchildren. Fathers, on the other hand, may be more concerned with establishing status relationships and accruing resources because male reproductive success is more closely tied to status than is female reproductive success.

In traditional societies where high brideprices are conditional on the chastity of the daughter, parental control of a girl's sexuality may have economic and reproductive rewards for fathers. In polygynous societies, the brideprice gained from chaste daughters may be used to purchase more wives for the father, enabling him to produce more children. Therefore, fathers may have evolved to take a particular interest in controlling the sexual and reproductive activities of their daughters. In industrial societies this disposition may be reflected in an increased concern over daughters' activities compared to sons (Devereux, Bronfenbrenner &

Rodgers, 1969), with fathers becoming more protective and controlling of their daughters following menarche (Hill, 1988). Similarly, Flinn (1988b) has observed fathers in a Caribbean village engaging in a number of behaviours, which he suggests are to ensure the proper sexual conduct of their daughters, and which he refers to as "daughter-guarding".

Social influences on human fertility and menstrual cycles

In many mammalian species, female reproductive physiology and behaviour are sensitive to cues in the social and physical environment. This is not surprising considering the enormous amount of energy that is invested in gestation and lactation. A female that reproduces in environments not conducive to the survival of offspring will have reduced fitness compared to one capable of monitoring the environment and reproducing under optimal conditions. Therefore, environmental influences on human reproduction may reflect adaptive responses that have evolved in the life history of our species.

Homo sapiens is a highly social species and there is some evidence that social interactions or exposure to other individuals may influence the menstrual cycle. In a now classic study, Martha McClintock (1971) recorded the menstrual cycles of dormitory residents in a women's college during the academic year and found that the cycles of roommates and close friends became synchronized. In this same article, McClintock also reported that women who dated men more than three times a week experienced cycles of shorter duration than those who did not see men so frequently. These findings attracted considerable attention and inspired a number of studies of social influences on the human menstrual cycle in the following decade.

Graham and McGrew (1980) studied university women and found that those who considered themselves close friends developed menstrual synchrony in the first four months of the study, even though they lived apart. However, these authors did not find a significant

correlation between cycle length and time spent with men. Quadagno and colleagues (1981) also reported menstrual synchrony in a coeducational environment, but failed to find a relationship between spending time with men and the length of the menstrual cycle. However, Veith and colleagues (1983) found that women who spent two or more nights with men during a forty day period had a higher rate of ovulation than those spending none or one night with men, although sleeping arrangements were not related to cycle length. It has been suggested that interactions with male and female individuals may influence the human menstrual cycle in ways analogous to those found in other mammals. One possibility is that primer pheromones or olfactory cues emanating from males and females may cause a reorganization in underlying physiology.

A major problem with the early studies in this area, however, is that they are correlational and causation can not be inferred. Correlational information tells us nothing about the direction of effects. It is just as possible that men are more attracted to ovulatory women (there is some evidence that male primates can detect estrous cycles by olfactory cues) and that this is the reason why exposure to men and shorter cycles are related. Another possibility is that the same physiological factors influencing ovulation or length of the menstrual cycle influence the motivational state of a woman, so that women who are ovulatory are also highly interested in interactions with men.

The first double blind experimental studies examining the effects of male and female odours on menstrual cycles were conducted in the past few years by researchers at Monell Chemical Senses Centre (Preti, Cutler, Garcia, Huggins & Lawley, 1986; Cutler, Preti, Krieger, Huggins, Garcia & Lawley, 1986). In the first experiment, extracts of male axillary secretions or a blank-ethanol (control) solution were rubbed on the upper lips of females who had menstrual cycles of aberrant lengths. At the end of 14 weeks of treatment the cycles of women who had received male axillary secretions were less variable and aberrant in length than

those of women who had received the control solution. The second experiment followed the same procedure except that axillary secretions from female donors collected throughout the menstrual cycle were applied to women with cycles of normal cycle length. After 13 weeks the number of days difference in the onset of the menstrual cycle in recipients and donor was significantly reduced, indicating that synchronization had occurred.

These first two experimental studies confirm that the human menstrual cycle can be influenced by exposure to other individuals and that male and female odours alone are effective in creating menstrual synchrony and regularizing cycle lengths. It is possible that such effects endure in the human species either as a functionless vestige of our mammalian heritage or perhaps they have retained some functional significance. However, the possibility that exposure to individuals may influence other aspects of ovarian function, such as the timing of menarche, has not been systematically examined.

Summary and research goals

The study of human menarche includes an examination of the changing physiology, psychology and behaviour of women at the beginning of their reproductive lifespans. In this respect, it may provide a unique glimpse into the selective forces that have shaped the life history of the human female. The study of human development may be enriched and enhanced by considering it from a broader perspective and in light of the existing non-human literature. Human females have much in common with other non-human primates and other mammalian females, but also differ in several important respects.

Like the females of many other species, human females appear to have evolved to adjust the timing of reproductive events according to environmental conditions. The influences of particular environmental factors, such as interactions with other individuals, on human

menarche, have not been extensively explored. The research described in the following chapters constitutes the first large scale study examining the relationship between family composition and the timing of human menarche, in conjunction with other factors known to influence menarche. The present chapter reviewed a number of general perspectives on the timing of human menarche and suggests why examining the influence of family composition may be illuminating. Subsequent chapters, outlined below, describe the methods and results of two surveys conducted in the past four years which attempted to investigate this unexplored influence on the timing of human menarche.

Chapter 2 outlines the general methods by which the surveys were conducted and describes the questionnaires. The general demographic characteristics of the sample and the distribution of the age at menarche are reported. These general results are compared with previous reports. The manner in which sampling methods may interfere with the examination of specific influences on the timing of human menarche is discussed.

Chapter 3 determines if the classic effects of social variables, such as SES, urbanization, family size, birth order, height and weight are present in this sample. The influence of "stress", as defined by scores on a life events inventory, on the timing of human menarche is also explored.

Chapter 4 discusses the possible reasons for the secular decline in the age at menarche and proposes that such factors may also influence menarcheal age within a population at any one time. Evidence of a secular decline and of seasonal variation in the timing of menarche is examined.

Chapter 5 examines whether interactions with other people, particularly family members, are related to the timing of menarche in ways analogous to those observed in other species. The age at menarche in girls from families with one or both parents absent is compared to that of girls who grew up in the continual presence of both parents. The relationship between number of brothers and sisters and the timing of human menarche is also examined.

Chapter 6 suggests how both hereditary and psychological influences may be involved in the relationship between family composition and menarche. A multiple regression analysis is employed to determine the amount of variance in menarcheal age explained by the variables examined in this research.

Chapter 7 summarizes the research findings and discusses how this research has contributed to our understanding of the timing of human menarche.

CHAPTER 2. GENERAL METHODS AND CHARACTERISTICS OF THE SAMPLE

To investigate the relationship between family composition and menarcheal age, two surveys, involving 1,314 participants, were distributed in Ontario between 1984 and 1987. The first survey was distributed to female university students in two southern Ontario cities and constitutes the first large scale investigation of this topic. Results of the first survey led to the distribution of a second survey which was designed to explore parental influences on the timing of menarche. These included genetic influences and parental attitudes, which could not be reliably established from daughters' responses. While the first survey was designed for women only, the second survey solicited responses from Ontario women and one or both parents.

This chapter describes the design, distribution and coding of both surveys. The average age at menarche and other characteristics of mothers and daughters are reported to give an overview of the sample and to assess the reliability of the recalled age at menarche and the representativeness of the sample. Results regarding specific influences on the timing of menarche are reported in subsequent chapters.

General Methods

SURVEY I

The first questionnaire (Appendix A) was initially developed in 1984 and consisted of a number of items including questions about the recalled age at menarche, season of menarche, family composition, whether the respondent grew up in an urban or rural environment,

socioeconomic status and a life events inventory. This survey was distributed to female undergraduate students at Brock University, St. Catharines and McMaster University, Hamilton, between 1984 and 1987. During this time the questionnaire underwent slight modifications involving small wording changes and the addition of questions regarding current height and weight, but otherwise remained the same. Over 1,200 questionnaires were distributed by either of two methods: 1) they were distributed and completed in class time or 2) they were distributed one day and picked up in the following class.

All information about the age of menarche and associated factors was obtained retrospectively. Subjects were instructed to give their menarcheal age in years and months, which was converted to years and decimal fractions of a year for analysis. In those cases where only the year and not the number of months could be recalled, the age of puberty was adjusted by adding 0.5 years. Since some girls remember their age at menarche in whole years only (e.g they know that they had their 12th birthday, but cannot remember how many months over twelve years of age they were), adding 0.5 years, or the average of all possible numbers of months, is generally accepted as a suitable adjustment (Livson & McNeill, 1962). The adjusted and unadjusted data were pooled and all subsequent analyses are based on these pooled data.

Using a six-point scale, respondents were asked to indicate how close they believed their reported age of menarche was to their actual age. Because the retrospective method is less accurate than other methods, this question was intended to give the researcher an estimate of the accuracy of the recalled age at menarche. This question was preferred to one asking about the "confidence" of a participant in her answer (e.g. 100% confident, 50 % confident) because it was more easily understood and indicated the magnitude of the recall error. Previous research has shown there is a tendency for early and late maturers to misreport the age of

menarche in order to appear more normal (Peterson, 1983). Unhappy or painful memories about the onset of menses and the desire to appear normal may motivate women to both misreport and forget the date of menarche. To determine whether these factors could be affecting the reported age of menarche, a three point scale was devised to measure the respondent's feelings about the timing of menarche. Participants were asked whether they had wished that menarche had occurred later, earlier or had no preference as to the timing of menarche. An analysis of variance was conducted to determine if the average age of menarche was different in the three groups of responses.

Season of menarche and the month of menarche, if indicated, were also recorded. The month of menarche was reported by 614 or 49% of the respondents. A chi-square test was performed on the reported season of menarche (N= 1,163) and the month of menarche to determine if the occurrence of menarche was seasonal. The average age of menarche occurring in each season was also computed and an analysis of variance performed to determine if season had any effect on the age of menarche.

The age, sex and period of coresidence with the respondent was recorded for each other child living in her home while she was growing up. Family size, or the total number of children (including the participant and her full and half siblings), and the number of brothers and sisters was calculated from this information. The number of years, in whole numbers, of contact with brothers and sisters prior to menarche was computed as follows. If a girl shared the household with just one older brother until she reached menarche at 13 years of age, the total years of exposure to males was 13 and to females 0. If, on the other hand, she had two younger sisters who lived with her for 4 and 2 years respectively before she reached menarche, the total years of exposure to females would be 6 and the years of exposure to males would be 0. The numbers of years of exposure to a genetic mother and father and to other

related and unrelated guardians were similarly calculated.

Participants were assigned codes according to whether they lived with both, one or neither natural parents continuously before they reached the menarche. Most girls reported that they grew up in the continual presence of both parents. However, some girls experienced the absence of a mother or father during this time, and were coded as mother-absent or father-absent accordingly. A smaller percentage of girls reported that they had experienced the absence of both parents, either consecutively, or because they had been adopted shortly after birth. The reason for the parental absence, if given, (e.g. death, divorce or other) and the age at which the absence occurred was also recorded, as was the addition of a stepparent to the household after the departure of a parent.

Socioeconomic status was determined by the father's occupation in accordance with the Blishen and McRoberts social class scale (1976). This index ranks occupations on a continuous scale based on the combined variables of education, income and community status. These rankings can then be divided into six socioeconomic classes (according to criteria given in Blishen & McRoberts, 1976), with the first category representing the highest class and the sixth category the lowest.

Participants were asked to indicate the degree of urbanization of the community they lived in while growing up. The choices consisted of six categories ranging from highly urban (1) to very rural (6) communities.

As a measure of stress, respondents completed a life events inventory designed for junior high school children (Coddington, 1972). The inventory consisted of 39 items which include most major and minor changes and stressors in children's lives, such as moving to a new school district or death of a parent. Each event is weighted according to its severity, with "breaking up with a boyfriend" given a lower weighting than "divorce or separation of

parents". This scale was originally designed to ascertain the events leading up to the psychological disturbance of a child in the one or two years preceding an illness. However in this survey, participants were asked to indicate which events had occurred while they were growing up and the age(s) at which they occurred. The total frequency of each event in the first 10 years of life (up to a maximum of three) was then multiplied by the weight assigned to that event and the total score summed. The total score on this scale provided a relative measure of the stress a girl had experienced compared to other girls in the sample.

The age at which a girl began dating was included in the life events inventory, but since girls in the first survey were only instructed to check the number of events occurring between birth and 15 years, not all girls gave the age when they first began to date. Fortunately many girls filled out this item regardless of when they began dating (947 or 76% of the total 1,247 cases). Nevertheless, the inadvertant removal of some of the higher values of this variable could have possibly led to a bias in the reported age of dating as mainly those girls who began dating before 15 would have been included in the analysis.

Information on current height and weight was not collected in the first two years of the study but was included in subsequent years. Therefore, of the total number of participants approximately 35% reported their current height (N= 444) and weight (N=436). The Quetelet Index (Keys, Fidanza, Karvonen, Kimura & Taylor, 1972; Khosla & Lowe, 1967), a measure of weight per height (Weight/height^2 x 10000) was calculated from this information.

SURVEY II

The second survey was designed to examine parental influences on the timing of menarche, and was distributed in 1987 to daughters and one or both parents. Families were recruited by advertising in St. Catharines, Hamilton and Toronto newspapers (see examples in

Appendix B), by posting notices on bulletin boards at McMaster University and local laundromats, by contacting the Hamilton and St. Catharines' chapters of Parents Without Partners, by referral from acquaintances at Brock and McMaster Universities and by mailing survey packages to the families of first year female students randomly selected from the Brock Student Union Directory. Since results from the first two years of distributing Survey I indicated that less than 15% of girls in the population reported parental absence, an attempt was made to increase the proportion of girls who had experienced parental absence. For example, newspaper advertisements specified that the researcher was particularly interested in hearing from women who had experienced the absence of one or both parents.

The survey packages contained three types of questionnaires designed for each of the different family members (Appendix C). The questionnaires for parents were essentially identical, except that the questions regarding physical development of fathers and mothers employed different measures of puberty. Both questionnaires included items regarding parents' age at puberty and dating, the birthdates of all children and attitudes toward heterosexual relationships, the family and males. The daughter's questionnaire was a modified version of Survey I. Some items were deleted and in their place the attitude scales (described below and included in the parents' questionnaires) were added.

To facilitate the comparison of daughters' and parents' attitudes all questionnaires contained the same three attitude scales: (1) a modified version of the Value Inventory (Sherriffs & Jarrett, 1953) (attitudes towards men and women in which positive or negative characteristics are attributed to either sex); (2) a modified version of the Dating Scale (Bardis, 1962) which measures attitudes toward heterosexual relations in young people along a liberal-conservative continuum; and (3) a modified version of the Family Scale (Rundquist & Sletto,1936) which measures positive or negative attitudes toward the family.

The Value Inventory (Sherriffs & Jarrett, 1953) was modified by deleting some outdated items, making some small wording changes to update the language and reducing the number of items to a total of 22. This scale consists of a number of statements describing various human attributes (e.g. "shirks family and personal responsibilities"). Some of these items referred to desirable or positive attributes (e.g. "reliable and dependable") and the remainder to negative attributes (e.g. "most subject to violent outbursts of temper"). Participants were instructed to read each statement and indicate whether it best described men or women or whether it described each sex equally. A high negative score on this scale indicates that the respondent attributes more negative characteristics to men than to women. A high positive score suggests that the respondent views men more favourably than women.

The Dating Scale (Bardis, 1962) was also modified by deleting some outdated items and modernizing the wording, which resulted in 22 remaining items. It consists of a series of statements about heterosexual relationships (e.g. "It is not important for a person to remain pure until marriage") for which the participant indicated, using a 5-point Likert scale, that he or she either strongly agreed, agreed, was undecided, disagreed or strongly disagreed. Values on this scale were totalled, with high scores indicating more liberal attitudes and low scores more conservative attitudes toward heterosexual relationships.

The Family Scale (Rundquist & Sletto, 1936) is a 15 item test that measures positive and negative views toward the family by means of a 5-point Likert scale as described above. Half the items express a positive view of the family (e.g. "Home is the most pleasant place in the world") and are given a positive value and the remainder reflect a negative view of the family (e.g. "One cannot find as much understanding at home as elsewhere") and are given a negative value. The scores are totalled, with a score of around zero representing a neutral view of the family, a positive score, a positive view of the family, etc. Since both the Dating and

Family scales employed the same kind of Likert rating system the items of these scales were randomly mixed together and appear in all three questionnaires under the heading "Attitudes toward family life and family members".

Results: General characteristics of the sample

A total of 1,314 questionnaires were returned from both surveys. Thirty-nine of these questionnaires were not included in the analysis because the respondent had suffered from a major endocrine or other physical illness known to have a profound effect on the age of menarche, had spent a substantial portion of her life in another country or had only completed a small percentage of the possible questions. Of the remaining questionnaires, 1,158 were completed by daughters, 89 by mothers and 28 by fathers. Since mothers and daughters completed questionnaires with many identical items and there was considerable overlap in the age range of the "daughters" in Survey I and the "mothers" in Survey II, the information from all female participants in both surveys was pooled. This pooled sample of 1,247 females was utilized in most of the statistical analyses discussed in the following chapters, except where otherwise indicated.

The basic characteristics of the pooled sample of all women participating in this study are summarized in Table 2.

THE AGE OF MENARCHE

The average age of menarche in the entire sample was 13.00 ± 1.32 years with a range of 9.00 - 18.50 years. In this population, the frequency distribution of the age at menarche is slightly positively skewed with a median of 13.00 and a mode of 13.50 years.

Although the reliability or accuracy of the recalled age of menarche in this sample

Table 2. General characteristics of a sample of 1,247 Ontario women.

	N	M ± SD	Range
Menarche (yrs)	1211	13.00 ± 1.32	9.00 - 18.50
Family size	1149	3.06 ± 1.89	1 - 12
Number of brothers	1149	1.04 ± 0.98	0 - 7
Number of sisters	1150	1.01 ± 1.03	0 - 6
Birth order	1100	2.06 ± 1.37	1 - 12
Height (cms)	444	165.26 ± 6.55	147 - 182
Weight (kgs)	436	59.96 ± 9.71	41 - 125
Quetelet index	436	21.95 ± 3.23	14.69 - 42.53
Socioeconomic index score	1018	50.28 ± 16.31	22.70 - 75.80
Life events score	1137	151.35 ± 119.88	0 - 901
Age dating began (yrs)	947	14.54 ± 1.68	8 - 23

cannot be directly determined it is likely to be fairly high. A large proportion of the respondents were young, in their early twenties, and thus had entered puberty in the last ten years. Most studies indicate that recall is better in younger subjects than older. In this sample, the year of a participant's birth was significantly and negatively correlated with how close they believed their reported age at menarche was to their actual age ($r(924) = -.13$, $p \leq .01$). This indicates that the older participants were less certain of their recalled age at menarche than were the younger participants. Fifty-one percent of all respondents stated that they "believed" their reported age of menarche was within 1 month of the actual age, 26% within 3 months, 16% within 6 months, 3% within 9 months, 4% within 12 months or over 12 months away. Thus 80% believed that their reported age was within 6 months of their actual age. Interestingly, many women reported that their recalled age was exactly accurate and indicated the date and often described the circumstances surrounding its occurrence (e.g. "on my 14th birthday")

The most common response regarding feelings about the timing of menarche was that respondents had no preference as to when menarche occurred (58.4%). Approximately 31% wished that menarche had occurred later and 10% that it had occurred earlier. The average age of menarche in the three groups of responses differed significantly ($F(2,948) = 56.83$, $p \leq .0001$): Women who responded that they wished menarche had occurred later were generally early maturers; those who wished that menarche had occurred earlier tended to be late maturers; while women who had neither desired that menarche had occurred earlier or later had an average age of menarche very close to the mean for the entire sample (Table 3).

FAMILY SIZE AND FAMILY COMPOSITION

Family size ranged from one to twelve children with a mean of 3.06 ± 1.38. The

Table 3. Comparison of the mean age at menarche in girls who reported that they would have preferred that menarche had occurred later, earlier or that they had no preference.

Preference	Age at Menarche		
	M	SD	N
Preferred menarche later	12.49	1.28	300
Preferred menarche earlier	13.98	1.34	100
No preference	13.13	1.23	551

$F(2, 948) = 56.83, p \leq .0001$

distribution of family size was highly skewed with a preponderance of smaller families. For example, 88% of participants had been reared in families with 4 or fewer children. Respondents had an average of 1.04 ± .99 brothers (range 0-7) and 1.01 ± 1.03 sisters (range 0-6). The average woman in this sample was the second child born in the family.

Of the total 1,247 women who completed both questionnaires, 1,152 could be coded as to whether or not they experienced parental absence. Nine hundred and forty-eight (82%) women reported that they lived with both parents continuously from birth until menarche, 146 (13%) reported that their fathers (but not their mothers) were absent for a period of time before they reached the menarche, 21 (2%) experienced the absence of their mothers (but not their fathers) before menarche, and 37 (3%) experienced the absence of both parents before menarche. In the latter group, girls experienced biparental absence either sequentially or because they were adopted. Since the proportion of parent-absent girls was deliberately increased in the second survey, only information from the first survey was examined to determine whether the proportion of girls with parental absence was representative of the North American population. Approximately 86% of girls participating in the first survey reported that they had lived with both parents continuously, while the remainder had experienced the absence of one or both parents.

SOCIOECONOMIC STATUS

The average index of socioeconomic status, as determined by father's occupation, was 50.28 ± 16.31. When the frequency distribution was divided into six classes according to Blishen and McRoberts' criteria (1976), peak frequencies occurred in the second and fifth classes and the lowest frequency was observed in the fourth class.

URBAN/RURAL DWELLING

Girls reported growing up in a wide range of communities from the highly urban to the highly rural. For example, 11% grew up in large metropolitan centres, 28% in medium-sized cities, 27% in small cities, 20% in semi-urban communities, 8% in semi-rural areas and 6% in highly rural communities.

LIFE EVENTS SCORE

The level of stress before age 10, as indicated by totalling the number of life event units, had a range of 0 - 901, with an average of 151.35 ± 119.84 units. The distribution of life event scores was positively skewed, with a median of 129 units and a mode of 50 units.

DATING

On average girls began dating at 14.54 ± 1.68 years of age. In general, girls began dating 1.5 years after the menarche, although a few girls reported that they began dating before menarche or many years following menarche. The age girls began dating was positively and significantly correlated with menarcheal age ($r(831) = .20, p \leq .001$)

HEIGHT AND WEIGHT

The average woman in this sample weighed 59.96 kilograms, was 165.26 centimeters tall and had a Quetelet Index of 21.95. The distributions of height and weight were approximately normal, notwithstanding two extreme weight values of 113 kgs and 125 kgs. Since obesity may suggest hormonal imbalances that may substantially alter the timing of puberty, analyses were computed involving both the removal and retention of these extreme scores. In general, the results of both analyses did not greatly differ and all results reported in

subsequent chapters were computed retaining the two extreme scores.

Discussion

In this sample, the average menarcheal age of 13.00 years was similar to the age reported for a random sample of Montreal schoolgirls from different socioeconomic strata (13.08) and an earlier retrospective study conducted in Southern Ontario (12.96)(Buck & Stavraky, 1967; Jenicek & Demirjian, 1974). Moreover, this mean age corresponds closely with that found by independent researchers at this same location (13.01)(Hapidou & deCatanzaro, 1988). This average menarcheal age is about 2 months older than that reported for whites in the United States (Zacharius, Rand & Wurtman,1976) and is concordant with the average age reported for London girls (Tanner, 1973). In addition, the average woman who participated in this study came from an upper-middle or lower-middle class family of three children and had one brother and one sister. She was on average, the second child born into a family and achieved an adult stature of 165 cms and weight of almost 60 kgs. Dating activities usually began 1.5 years following the menarche.

The proportion of girls in the first survey who experienced parental absence (14%) is probably low for the Canadian population-at-large. In a cross-sectional survey of the living arrangements of children in Hamilton-Wentworth in 1983, Daly and Wilson (1985) found that 10.5% of those aged 0-4 were living in households in which either the genetic mother or father was not resident, compared to 20.5 % of those aged 5-10 and 22.2% of those aged 11-17. Since this survey of household composition was cross-sectional, these figures probably represent a low estimate of the proportion of children experiencing the absence of either genetic parent sometime during childhood. Thus, the proportion of girls in this sample experiencing parental absence is undoubtedly lower than for the general Canadian population.

In retrospective studies of this nature, reliability of the recalled age of menarche can be a problem. Livson and McNeill (1962) compared the actual age at menarche of participants in a longitudinal growth study with the menarcheal age recalled many years after the study was completed, and found that they were moderately correlated and did not significantly differ. Damon, Damon, Reed and Valadian (1969) also reported a moderate correlation (r = .78) between the actual and recalled age at menarche in a longitudinal study conducted at the Harvard School of Public Health and did not find a significant difference between these ages. Recall can be improved by stressing the importance of accuracy and by suggesting that the participant recall other significant events occurring around menarche to aid her memory (Eveleth & Tanner, 1976). The survey instructions in the present research were therefore written to improve the accuracy of recall.

In general, the older the participant at the time of questioning, the greater the error of recall. The majority of women participating in this study were born in the early 1960's and were therefore in their early twenties when they participated. Accuracy of recall would be expected to be fairly high in this group and this assumption is supported by the large number of girls who believed that their recalled age of menarche was relatively close to the actual age at menarche. Comments like "exact answer", "occurred on Oct. 20 my sister's birthday" and "that's when it was! Believe me I remember! " were not uncommonly written on the questionnaire.

It is clear that most participants were cognisant of the population average and desired that their own menarche had occurred around this time. For example, two late-maturing girls who had wished that menarche had occurred earlier commented "was conscious of peers starting to menstruate and was anxious to be "part of the group".... I just wanted to be like my peers" and "all of my friends had it long before I did!" In contrast, one girl who attained menarche at

11.00 years wrote "I wanted it to go away!". Therefore, it is possible that some women with particularly early or late occurrences may have biased their responses to appear more normal. Neither Livson and McNeill (1962) nor Damon and et al. (1969) found systematic significant biases of this nature in their data. For example, the latter authors found that menarcheal age and the direction of the error of recall were independent. I have no reason to suspect that any systematic errors of recall have occurred in this sample. If a bias toward the mean occurred in this sample it was not great enough to eliminate the differences in the mean menarcheal ages of women who would have preferred that menarche had occurred later, earlier or who had no preference regarding the timing of menarche.

In Canada the distribution of social class according to occupation is skewed, with many more office, service and production workers than managers and professionals (Veltmeyer, 1986). As one would expect, the upper classes appear to be over-represented among university students (Forcese, 1975). Although the first survey was distributed to university students, the distribution of SES indicated that it was not a homogeneously upper class sample and that a significant number of children of skilled workers were also included. Since this sample was obtained from university populations in the industrial centre of Canada, it is not surprising to find an abundance of girls with parents in the professional occupations or who worked in the major industrial plants in the area (steel and automotive factories).

The second sample may have been even less representative of the population-at-large because it was self-selected. After viewing my advertisement, volunteers usually contacted me and offered to participate in the survey. Although participants were not aware of the specific goals of the research it is possible that particularly early or late-maturing women, or women who had had especially unhappy or stressful lives were more likely to volunteer. It is also possible that this second sample contained a disproportionate number of intelligent and

well-educated women, as most women who called appeared to be interested, knowledgeable and articulate.

In summary, the recalled age at menarche in this sample is believed to be fairly reliable, is concordant with previous estimates and is highly variable. The considerable variability observed in most demographic characteristics suggests that this sample represents an adequate cross-section of this population to enable the examination of differences in the timing of menarche according to social variables. Self-selection of some subjects and the distribution of questionnaires to university students has undoubtedly reduced the representativeness of the sample. Nevertheless, increased homogeneity in basic demographic characteristics and socioeconomic class may facilitate the detection of more subtle differences, such as those due to family composition, which might otherwise be obscured by the stronger effects of factors such as health and nutrition.

CHAPTER 3. CLASSICAL SOCIOENVIRONMENTAL EFFECTS ON THE TIMING OF MENARCHE

The timing of menarche appears to be influenced by factors in the social environment as well as by those in the physical environment. This chapter examines the relationship between menarche and socioenvironmental variables, such as socioeconomic status (SES), family size, birth order and urbanization. These factors have been examined in a large number of populations and their effects are well-documented. However, this study may be the first to examine psychological stress, as measured by scores on a life events inventory, as a possible factor influencing the timing of menarche.

Socioenvironmental influences on height, weight and timing of menarche

Socioeconomic status has long been known to be associated with the timing of menarche. In early 20th century Britain, lower class women experienced menarche on average 0.5 years later than upper class women (Frisch, 1983). The socioeconomic differential in age of menarche persists in many modern populations. For example, Aw and Tye (1970) noted a difference of .6 years between high and low class Singapore girls; upper and lower class Hong Kong girls differed by .75 years (Lee, Chang & Chan, 1963); and poor Bantu-speaking South African girls matured .4 years later than girls from more wealthy homes (Burrell, Healy & Tanner, 1961). Social class effects, however, have been found to be absent in some countries with little social stratification (Lindgren, 1976).

Family size also tends to be related to the age of puberty (Valsik, 1965; Jenicek & Demirjian, 1974). Generally, menarche is delayed in girls from large families and this may

be due to the limited resources available in any one household. The more children in a family, the smaller is each one's share of the resources, and this may result in a corresponding delay in development. For example, Stukovsky and colleagues (1967) found a significant linear relationship between age at menarche and number of siblings, with menarche delayed by 2.1 months for each additional child. In a seemingly conflicting report, Roberts and Dann (1967) found that birth order was related to menarcheal age and that girls born later in a sibship had a lower age at menarche than girls born earlier. James (1973) suggests that these reports can be reconciled if both birth order and family size are considered together. Birth order effects have not been reported in many populations. For example, Carfagna, Figurelli, Matarese and Matarese (1972) did not find any effects of birth order in a sample from Naples when they examined families with six or more children. SES, family size and birth order are correlated phenomena and their effects are probably interdependent. Family size effects may only be observed when there is a relationship between family size and SES, for example, when low SES is related to large family size.

Urban/rural differences in the age of menarche show a consistent pattern which may also be associated with socioeconomic class. In almost every population reviewed, girls living in urban environments tend to have an earlier age of menarche than their rural counterparts (Eveleth &Tanner, 1976). In many countries children in urban centres are larger than children in the surrounding country side. Urban children usually live in better circumstances than rural ones as urbanization is associated with sanitation,health and medical services, a continuous supply of goods, educational centres and recreational and welfare facilities. Differential immigration of families with fast-maturing girls into urban centres may also contribute to urban/rural differences in menarcheal age.

Nutrition or health is probably the common denominator responsible for differences in

the age at menarche according to socioeconomic status, birth order, family size and urban versus rural dwelling. In 1974, Frisch and McArthur suggested that menarche would not occur until a critical weight per unit height was achieved. Presumably, there is a feedback system between the endocrine system and fat deposits such that girls who are too thin have a delayed menarche or lose their menstrual periods if they have already gone through the menarche. In general, plumper girls, or girls with more weight per height have an early menarche but both obese and emaciated girls have a delayed menarche (Frisch, 1977). Differences in access to high quality food and medical care among the different social strata and in families of different sizes most likely translate into differences in the rate of physical development through the mechanism of fat deposition. There is some evidence that body build is related to menarche independent of social class and family size. For example, Jenicek and Demirjian (1974) found in a study of Montreal schoolgirls that girls with linear physiques were older at menarche, but that physique, social class and family size were independent factors.

Menarche and body build

It appears that girls of differing constitutional body types mature at different chronological ages. Early human developmentalists noticed that girls who attained a lower adult height than average and who had particularly curvaceous figures tended to be early maturers (Bayley, 1943; Simmons & Gruelich, 1943). Having lower target heights, they presumably attained the critical weight for height necessary for the onset of menarche earlier than girls destined to become taller adults. On the other hand, girls with a disposition to be tall and thin tended to reach the menarche later than average as it took them a longer time to achieve the critical weight for height. This finding, however, is often confused with the finding of many cross-sectional studies that early maturing girls are taller and heavier than later maturing

girls. This discrepancy disappears when adult height and weights are considered. For example, Garn (1980) and Faust (1983) note that while early maturing girls tend to be taller and heavier at puberty than their peers they tend to achieve a lower than average adult height and tend to have more weight per height than later maturers. Moreover the growth spurt of early maturers, with its accompanying "fat spurt", seems to be more abrupt than that of late maturers, who seem to grow more gradually (Simmons & Gruelich, 1943). The inheritance of menarcheal age appears to be associated with the inheritance of stature, as early maturing women tend to produce children who also mature quickly and have a lower adult stature.

Stress and physical development

Stress, depending on whether it is physical or psychological, intense or chronic, seems to have mixed and sometimes paradoxical effects on immature and mature females. Females who have already gone through puberty, for example, may develop amenorrhea, anovulation and other menstrual irregularities in response to stress (e.g., Dalton, 1969). Intense physical stress in prepubertal girls, such as rigorous athletic training, is associated with a delay in menarche (Dale, Gerlach & Whilhite, 1979; Frisch, Wyshak & Vincent, 1980). On the other hand, acceleration in growth and maturation in younger females has been associated with early stressful experiences. For example, in a cross-cultural analysis Whiting (1965) found that menarche occurred earlier in societies where females were subjected to stressful childrearing practices (e.g. the shaping of craniums and limbs) in the first two weeks of life. These effects may seem mixed and paradoxical because the term "stress" is often applied to very different factors whose effects have different physiological consequences. Physical stressors, such as disease, and emotional stressors, such as death of a loved one, may be expected to have profoundly different effects on the physiology and psychology of the individual involved.

The concept of "stress" and its measurement has undergone a great deal of scrutiny and controversy in the psychological literature. While a relationship between "stress" and mental and physical illness has been suspected for thousands of years, only in this last century has systematic study of this relationship occurred. The concept of stress and the methods of research employed in its study have especially undergone considerable change and refinement in the last few decades. The earliest models of stress focussed on the physiological and homeostatic processes of the organism in response to interference, a noxious substance or a perturbation that disrupted equilibrium. The most influential of these early "biological" models was Hans Selye's "General Adaptation Syndrome" (Selye, 1946). While engaged in the search for a new sex hormone, Selye identified a cluster of physiological responses that occurred in response to such damaging stimuli as bacteria, toxins, trauma and extreme temperature. These involved changes in the pituitary, thymus, adrenal and gastrointestinal tract, whose persistence after the trauma had dissipated was associated with disease. Selye argued that stress was primarily a physiological response and his work has greatly contributed to the fields of psychosomatic research and psychoendocrinology. However, viewing stress as a general physiological response to non-specific stimuli is not particularly useful with regard to prediction and intervention in the disease process.

Holmes and Rahe (1967) considerably altered the definition of stress when they changed the focus from physiological response to the search for objective and specific stressors predictive of illness. Their emphasis on viewing stress as a stimulus comes closest to the layman's interpretation of the term and the idea that life stresses and strains, trauma and strife lead to mental and physical illness has been around for centuries. This approach, the life events approach, is focussed on the problem of establishing objective criteria for stressful stimuli in determining what life events are most predictive of illness. Holmes and Rahe

(1967) pioneered this field with the introduction of the Social Readjustment Rating Scale, an inventory of 43 major events that were weighed according to the life change they incurred. Total score on this scale was found to be modestly correlated with symptomology. Early criticism of this scale focussed on the methodology employed in the weighting of items and has led to the development of more refined scales. The life events model is basically a stimulus-response model which ignores the interaction of individual coping styles and reactions with the presence of a stressor. The latest models of stress (Janis, 1977; Lazarus & Folkman, 1984) view stress as a dynamic and interactive state of the organism and reflect the emergence of cognitive and information processing models in psychology. They focus on the importance of coping mechanisms and individual differences in vulnerability to certain stressors.

"Stress" may have become an over-used term, referring to a multitude of different factors and processes and care must be exercised in its use. Hinkle (1974) has advocated that the term be completely abandoned in favour of more precise terminology. Mason (1975), however, suggested that the term still has heuristic value and should not be abandoned just because it refers to a number of different factors.

Because previous research has suggested that there may be a link between certain stressors and rate of development, a life events inventory was included in the questionnaires distributed in Survey I and II (see Chapter 2). Therefore, in the present research, "stress" was defined as the total number of changes, weighted by their importance, that an individual experienced in a certain period of time. This measure was chosen because it could be readily incorporated into the questionnaire format.

Methods

To begin the investigation, correlations between menarche and all the other relevant socioeconomic variables were calculated. For descriptive purposes, some variables were then divided into a number of groups of approximately equal size and an analysis of variance was performed on the group means. For example, to examine the effects of family size, the participants were divided into three groups of approximately equal size according to the number of children in their family. The age of menarche, as well as other pertinent socioeconomic variables, were compared for girls who had 1-2 , 3 and 4 or more siblings. Similarly, girls with birth orders 1 , 2 and 3 or more were compared on all the relevant variables. Moreover, an ANOVA was performed on the age of puberty in girls across the six socioeconomic classes to determine if there were differences in the age at menarche between classes. Urban/rural differences were similarly examined.

Correlations between the age at menarche and height,weight, the Quetelet and the amount of stress to which a girl was exposed in the first ten years of life (total life events score) were also calculated. In addition, a median test was conducted on low and high stress groups to describe the difference in the average age at menarche in girls who reported experiencing high and low levels of stress.

Results

SOCIOECONOMIC STATUS

When the SES scores were divided into six classes according to Blishen and McRoberts (1976) the average age of menarche in the different socioeconomic classes did not differ significantly (Table 4). There was a tendency for girls in the upper classes to report a later age of menarche than girls in the lower classes. For example, the mean age at menarche in

Table 4. The relationship between socioeconomic class, menarcheal age and other socioenvironmental variables ($M \pm SD$, n's are given in parentheses). The socioeconomic index has been divided into six classes with Class 1 representing the highest class and Class 6 the lowest.

	Socioeconomic Class						
	1	2	3	4	5	6	p-value*
Menarche	13.10 ±1.42 (149)	13.06 ±1.29 (203)	13.08 ±1.42 (162)	12.98 ±1.29 (135)	12.94 ±1.30 (188)	12.88 ± 1.23 (150)	.61
Height	165.75 ± 6.47 (52)	166.59 ± 6.37 (64)	164.66 ± 6.98 (44)	166.81 ± 6.09 (37)	165.40 ± 6.82 (48)	164.28 ± 6.96 (36)	.41
Weight	58.73 ± 8.56 (52)	59.89 ± 8.07 (64)	56.46 ± 8.01 (44)	59.42 ± 8.70 (36)	58.42 ± 8.02 (48)	61.00 ±14.10 (36)	.36
Quetelet Index	21.34 ± 2.53 (52)	21.54 ± 2.32 (64)	20.80 ± 2.43 (44)	21.35 ± 3.13 (36)	21.34 ±2.52 (48)	22.49 ± 4.01 (36)	.22
Life Events Inventory	154.99 ±115.02 (153)	162.31 ±118.27 (206)	148.93 ±123.52 (167)	159.29 ±127.52 (134)	132.96 ±104.83 (189)	147.56 ± 116.80 (154)	.20
Family size	2.98 ± 1.25 (153)	3.05 ± 1.29 (206)	3.10 ± 1.37 (168)	2.90 ± 1.09 (134)	3.09 ± 1.32 (191)	3.44 ± 1.68 (156)	.01
Birth order	1.88 ± 1.07 (148)	2.04 ± 1.23 (201)	2.02 ± 1.45 (162)	1.89 ± 1.16 (127)	2.13 ± 1.32 (188)	2.41 ± 1.66 (149)	.009

* p-values given are for the Brown-Forsythe analysis of variance as variances were significantly unequal.

class 1 (13.10 yrs) was over two months later than the mean age in class 6 (12.88), but this difference was not statistically significant. The classic effect of socioeconomic status on menarche is that girls in upper class families have been found to mature earlier than girls from lower class families. These results, while not statistically significant, are in the opposite direction to many previous findings. An analysis of variance ignores the ordinal property of classes and a correlation is the more powerful test of the relationship between SES and menarche. Socioeconomic status was not significantly correlated with the age at menarche ($r(897) = .04$, $p > .05$).

FAMILY SIZE

The analysis of variance suggests that there was a tendency for girls in families consisting of only one or two children to mature slightly earlier (by approximately one month) than girls in families of three or more children (Table 5), but this difference was not significant. Moreover, family size was not significantly correlated with the age at menarche ($r(1115)=.04$, $p>.05$).

BIRTH ORDER

An analysis of variance demonstrated that when girls were grouped according to birth order, firstborn children matured on average three months earlier than girls who were the second child in the family, with higher birth orders intermediate (Table 6). However, birth order was not significantly correlated with the age at menarche ($r(1070)=.03$, $p>.05$). The finding of a significant between-groups effect coupled with a non-significant correlation appears to reflect a non-monotonic relationship between birth order and menarche.

Table 5. The relationship between family size, menarcheal age and other socioenvironmental variables ($\bar{x}$ ± SD, n's are given in parentheses).

	Family size			
	Number of children			
	1-2	3	4+	p-value*
Age at menarche	12.94 ± 1.29 (428)	13.06 ± 1.38 (374)	13.05 ± 1.28 (317)	.39 BF
Height	164.86 ± 6.89 (142)	166.62 ± 6.29 (126)	165.48 ± 6.33 (89)	.09 BF
Weight	58.65 ± 8.83 (140)	59.37 ± 9.50 (126)	58.78 ± 8.83 (88)	.81 BF
Quetelet Index	21.58 ± 2.81 (140)	21.37 ± 3.00 (126)	21.43 ± 2.67 (88)	.84 BF
Socioeconomic Index	51.04 ±16.01 (375)	50.63 ±16.49 (341)	48.64 ±16.49 (294)	.14
Life events Score	136.88 ±118.59 (429)	144.26 ±118.26 (341)	179.70 ±120.54 (319)	.0001

* p-values given are for standard F-test, unless variances were unequal and the Brown-Forsythe (BF) analysis of variance was employed.

Table 6. The relationship between birth order, menarcheal age and other socioenvironmental variables (M ± SD, n's are given in parentheses).

	Birth order			
	1	2	3+	p-value*
Menarche	12.90 ± 1.34 (455)	13.17 ± 1.32 (317)	13.04 ± 1.32 (315)	.02
Height	165.51 ±6.43 (139)	164.72 ±6.69 (110)	166.86 ±6.45 (101)	.06 BF
Weight	58.88 ± 7.88 (137)	58.59 ± 9.37 (110)	59.35 ± 9.94 (100)	.83 BF
Quetelet	21.52 ±2.78 (137)	21.54 ±2.82 (110)	21.28 ±2.90 (100)	.74 BF
Socioeconomic Index	50.75 ±15.80 (405)	51.86 ±16.63 (292)	47.92 ±16.49 (288)	.01 BF
Life events Index	178.32 ±127.16 (455)	138.74 ±111.33 (323)	131.30 ±114.32 (319)	.0001

* p-values given are for standard F-test, unless variances were unequal and the Brown-Forsythe (BF) analysis of variance was employed.

URBAN/RURAL DWELLING

When the sample was divided into six groups, there were no significant differences in the mean age at menarche according to whether a girl grew up in a highly urban or a very rural community (Table 7). Girls raised in communities with the greatest degree of urbanization matured 3.5 months later than girls in the most rural category, but the overall difference between categories was not significant. Moreover, the degree of urbanization of the community in which a girl was reared was not significantly associated with her age at menarche ($r(947)=.04$, $p>.05$).

HEIGHT AND WEIGHT

Neither height ($r(340)= .05$, $p > .05$) nor weight ($r(337)= -.06$, $p>.05$) was significantly correlated with the age at menarche. However, the Quetelet index, a measure of weight per height, was weakly and negatively correlated with the age at menarche ($r(337)= -.11$, $p = .05$): there was a tendency for girls with more weight per height to be early maturers.

STRESS

Total score on the life events inventory was significantly and negatively correlated with the age at menarche ($r(1104)=-.14$, $p \leq .001$). Girls who reported high levels of stress while they were growing up experienced an early menarche. To illustrate this relationship, the sample was divided into high and low stress groups, or those having scores below or equal to the median score of 129. The mean age at menarche in these groups was significantly different (Table 8).

Table 7. The mean age at menarche according to whether the participant grew up in a highly urban (1) or a very rural (6) community.

	Type of community					
	(Urban) 1	2	3	4	5	(Rural) 6
Menarche	12.85	13.03	12.98	13.12	12.99	13.14
SD	1.43	1.34	1.28	1.34	1.27	1.42
n	100	269	256	184	80	60

$F(5,943) = 0.69$, $p = .63$

Table 8. Comparison of the mean age at menarche of girls expericencing low (≤ median value of 129 units) and high (> median value) levels of stress from birth to ten years of age.

	Menarcheal age		
	M	SD	n
Low stress	13.16	1.32	554
High stress	12.87	1.32	552

$F(1,1104) = 13.32$, $p \leq .0003$

Discussion

Socioeconomic status, family size, birth order and urbanization were not significantly related to the age of menarche. The average age at menarche in girls from each of the six socioeconomic classes did not differ significantly, although upper class girls tended to reach the menarche later than those from the lower classes. This result is in the opposite direction to most previous findings but is concordant with that of Jenicek and Demirjian (1974), who found that upper-class Montreal girls actually reached menarche later than lower class girls. An emphasis on fashion, thinness and dieting, in upper class, urban populations may be responsible for this reversal.

Presumably, large families have fewer resources available for any given child and this is reflected in a slower rate of development. In the present study, girls in families with one or two children reached the menarche two months earlier than girls from larger families but this difference was not significant.

While birth order was not significantly correlated with menarcheal age, an analysis of variance comparing mean menarcheal age according to birth order revealed that first born girls attained menarche significantly earlier than girls born second in a sibship. This finding contrasts with Roberts and Dann's (1967) report that Welsh college girls born later in large families had an earlier age at menarche than earlier born girls. These authors suggest that their finding could be a reflection of parents favouring younger siblings, the result of a rebound effect resulting from early stress or could be related to increased maternal age.

In 1976, Eveleth and Tanner reported that "In every urban-rural comparison so far reported urban girls have an earlier menarche than rural girls"(pp. 256). They noted, however, that the difference was very small in the USA and Australia (Jones, Leeton, McLeod & Wood, 1973; MacMahon, 1973). The difference in the average age at menarche between urban

and rural Ontario girls is also apparently small and not significant. It is possible that both SES and urbanization are not important factors in modern and relatively wealthy countries, such as Canada, where the level of nutrition and health care does not differ greatly between classes or regions. Alternatively, sampling from a primarily university population with an overrepresentation of participants from the upper classes, may have reduced social class effects.

Height and weight were not independently related to the the age at menarche. Weight per height (Quetelet index) was weakly but significantly correlated with the age at menarche. Girls with more weight for height tended to be early maturers.

Girls who experienced high levels of stress in childhood generally reached the menarche earlier than girls experiencing low levels of stress. Stress was defined by scores on a life events inventory which provided a relative measure of the change experienced by the respondents during a specified period of time. These results are in general agreement with the findings of Whiting (1965) and Landauer and Whiting (1981) that childhood stress is associated with accelerated growth and maturity, although their measure of stress differed considerably from the one employed in the present study. To the extent that "stress" is a multifarious but poorly defined concept, with poorly understood effects, these results must be regarded with reservation. Nevertheless, of all the variables examined in this chapter, life events score was the most significant predictor of menarcheal age.

CHAPTER 4. SECULAR CHANGES AND SEASONAL VARIATION IN THE TIMING OF MENARCHE

The secular decline in menarcheal age has been described as one of the most profound biological events in recorded history (Konner & Shostak, 1986). One of the goals of this chapter was to examine the present sample of Ontario women for evidence of this decline. A second goal was to describe the seasonal variation in the occurrence of menarche and its relationship to menarcheal age in this population. Moreover, the seasonal distributions of menarche in women born before and after 1960 were compared for evidence of a secular change.

Secular decline in menarcheal age

During the last century a marked decline in the age of menarche in Western European and North American populations has occurred. Between 1830 and 1960 the average age at menarche dropped in Norway, Sweden, Finland, Great Britain, Germany and the United States, by approximately 3-4 months per decade (summarized in Tanner, 1962). For example the average age of menarche in Norway was around 17 at the beginning of this period and declined to approximately 13.5 years by 1950. A concomitant increase in height and weight has occurred in both boys and girls during this same time period, resulting in nine year old children in 1960 having equivalent size to ten year old children in 1930 (Tanner, 1962).

There is increasing evidence that the secular trend toward earlier menarche is slowing down and that the age at menarche has stabilized in several populations. For example, Damon (1974) reports an identical age at menarche (13.1 years) for mothers and daughters attending

private women's colleges in Massachusetts between 1930 and 1970. By 1973 the age at menarche in Oslo and London girls had also stabilized, while the age continued to fall in Holland, Copenhagen and West Hungary (Tanner, 1973). Several explanations for the secular decline in the age at menarche have been advanced. There is little doubt that improved nutrition and health care have played a role in this decline, as it appears that a critical amount of fat per unit height must be deposited before menarche can be achieved (Frisch & McArthur, 1974). While quality of life may have improved in the last century, some authors have suggested that improvements in nutrition alone may not account for the steep decline in age at menarche. An number of alternative and intriguing hypotheses have been advanced.

Adams (1981) attributes the decrease in the age at menarche and the accompanying increase in height and weight to an increase in stimulation and stress in modern industrialized society. He believes that increased levels of crowding, handling, noise, light and smells common to such societies are sources of increased stimulation. Among the pieces of evidence he cites in support of his hypothesis is the finding that urban girls tend to go through menarche earlier than their rural counterparts (see Eveleth & Tanner, 1976).

In 1985, after considering the growing literature on pheromonal effects on the age of maturation in non-human mammals, Burger and Gochfeld (1985) suggested that a change in the pheromone environment, due to more mothers working outside the home and more fathers spending time at home, may have resulted in the secular decline. This argument is based on the empirical findings that in some species exposure to adult females delays the onset of menarche in juvenile females while exposure to adult males accelerates puberty. Therefore, Burger and Gochfeld hypothesized that increased exposure to fathers' odours and decreased exposure to mothers' odours may be responsible for the early menarcheal age of 20th century girls. However, in formulating this hypothesis these authors did not take the relatedness or

familiarity between the pheromone donor and recipient into account. As discussed in Chapter 5, if inbreeding avoidance mechanisms are involved in conspecific effects on female maturity, then a critical factor may be the familiarity or relatedness between pheromone donor and recipient. For example, we might expect to find that the presence of related or familiar adult males is associated with a delay in the timing of menarche while the presence of an unrelated or unfamiliar male is associated with no change or an early puberty. Burger and Gochfeld also do not consider that the beginning of the decline in menarcheal age preceded the movement of women into the work-force by at least half a century. Although Burger and Gochfeld's hypothesis is speculative and perhaps misconceived, the idea that changes in a girl's family environment may affect her development is intriguing and will be discussed in more detail in Chapter 5.

Jafarey, Khan and Jafarey (1970) suggested that the use of artificial lighting in the last century may also be partially responsible for the secular decline in the age at menarche. Light is known to influence pineal secretions, particularly melatonin. In general, melatonin inhibits the release of gonadotropins, and in turn, light suppresses the release of melatonin. By inhibiting the release of melatonin, exposure to artificial lighting may have increased the level of circulating gonadotropins and facilitated an earlier onset of menarche. Many laboratory researchers have inadvertently discovered that female rats kept under conditions of continuous illumination, rather than on diurnal light/dark cycles, have an earlier onset of puberty (Fiske, 1941; Reiter, Rubin & Rihert, 1968). The artificial lighting hypothesis is particularly intriguing because it connects the two observations of secular changes in the seasonal distribution and timing of menarche to a common cause: changing exposure to light. It is possible that the same mechanism which has resulted in a lower age at menarche in this century has also influenced secular changes in the seasonal pattern of menarche. Therefore,

the finding of a secular change in the seasonal variation of menarche could have some interesting implications and may lend support to the idea that the use of artificial lighting in this century may have influenced the occurrence of menstrual cycles.

Broman, Dahlberg and Lichtenstein (1942) suggested that the acceleration of growth concomitant with the decline in menarcheal age may be due to increased outbreeding in the modern world. This hypothesis is based on the assumption that if some degree of dominance exists in the genes coding for height, so that the offspring of a tall and a short parent is taller than the average of their heights, then mass immigrations may have increased the number of heterozygotes in the population and thus the average height. Tanner (1962), however suggested that there was little evidence for this effect and that it was unlikely to have occurred at a fast enough pace to explain secular changes in growth. Still others have suggested that changes in gene frequencies may have played a role in the secular decline. Cristescu (1975) noted that early maturers have a higher fertility relative to later maturers that is not accounted for by the age at marriage. Higher infant and maternal mortality rates are associated with increasing parity (Potts & Selman, 1979). Therefore, Cristescu argues that decreased mortality in this century may have reduced selection against early maturity and that the proportion of early maturing women in the population may have increased in the last century.

Whether any or all of the above explanations for the secular decline in menarcheal age are correct, they are certainly interesting. Moreover, such explanations for the secular decline may also have some relevance in explaining the variation in the age at menarche within populations (see Chapters 3, 5, 6 & 7).

Seasonal influences on human reproduction

Seasonal influences on reproductive behaviour and physiology are ubiquitous in the

animal kingdom. In many species, seasonal light cycles, rain patterns and temperature fluctuations act to sychronize mating behaviour and births. Such reproductive synchrony may be advantageous as a means of swamping predators and taking advantage of food abundances occurring at certain times of the year.

Seasonal variation in the probability of conception has been documented for many human populations (Brundtland & Liestøl, 1982; Cowgill, 1966; Takahashi, 1964). In general, conception rates vary according to latitude, and the annual patterns found in the northern hemisphere are usually the reverse of those found in the southern hemisphere. Seasonal fluctuations in human conceptions have been associated with seasonal environmental cues such as temperature and hours of light per day (Jongbloet, 1983; Lincoln & Short, 1980). Reports that annual increases in dizygotic twinning rates closely match peaks in singleton births are evidence that higher ovulation rate may be the basis for seasonal peaks in conception (Surbey, deCatanzaro & Smith, 1986; Timonen & Carpen, 1968). The secretion of melatonin may play a role in such annual changes in ovarian function and has been implicated in the seasonal reproductive variation in mammals, including humans (deCatanzaro & Stein, 1984 ; Lewy, Wehr, Goodwin, Newsome & Markey, 1980; Petterborg, Richardson & Reiter, 1981).

While seasonal variation in human fertility is undoubtedly a reflection of our mammalian heritage, it is also influenced by cultural practices, such as taboos on intercourse and preferred dates of marriage (e.g. Johnson, Ann & Palen, 1975; Surbey et al., 1986). Seasonal variation in the occurrence of menarche, however, may be a more reliable indicator of annual ovarian activity, as it is less likely to be influenced by culture. It is readily understandable how conceptions and births may be influenced by cultural practices such as taboos against intercourse at specific times of the year, but it seems less likely that the

occurrence of menarche is influenced by such factors.

Age at menarche and its seasonal distribution

Seasonal variation in the occurrence of menarche has been observed in many populations (Valsik, 1965). For example, in the United States the peak months are May and June (Cagas & Riley, 1970), in Finland the highest frequencies occur in the summer and in December and January (Kantero & Widholm, 1971a) and among Japanese women born after 1960 menarche peaks in April, August and January (Nakamura, Shimura, Nonaka & Miura, 1986).

Reymert and Jost (1947) examined the carefully recorded menstrual records of girls growing up in Mooseheart, a community of families and children admitted upon the death of a father, and found that girls reaching menarche in the summer and winter months were older than those reaching it in other seasons. Similarly, Burrell and colleagues (1961) found a significant relationship between the seasonal occurrence and age at menarche in South African Bantu girls. Other authors have not found a significant association between the age at menarche and its seasonal distribution (Engle & Shelesnyak, 1934; Bojlen & Bentson, 1971).

Secular change in the seasonal distribution of conception and menarche

A secular change in the seasonal variation of conception or birth rates has been noted in several human populations (Cowgill, 1966; Surbey et al., 1986). These changes include a shifting of peaks as well as a general reduction in the amplitude of the seasonal variation in conception rates. A reduction in seasonal variation is believed to reflect the increase in technology since the industrial revolution. The invention and widespread use of artificial lighting, heating and air conditioners insulate modern humans from environmental fluctuations which may produce seasonal variation in fertility. Secular changes in the seasonal occurrence

of menarche have also been reported. Shimura and Miura (1980) examined the distribution of menarche in 17,545 Tokyo females born between 1881 and 1963. They found that in women born prior to 1890, the occurrence of menarche peaked in the spring month of April and that menarche in those born after 1920 became concentrated in April and August. A third peak in January emerged in their sample of women born after 1950.

Methods

To determine whether there was significant variation between seasons and between months in the numbers of girls reaching menarche, chi-square tests were performed on the combined data from both surveys described in the General Methods. To examine the relationship between season of menarche and the age at menarche a one-way ANOVA was performed to detect differences in the average age of menarche according to the season in which it occurred.

Since the majority of participants (80%) were born in the 1960's and the number of women born before 1960 was small, the seasonal distribution of menarche was compared in girls born before and after 1960. Similarly, to examine this sample for evidence of a secular decline, all women born before 1960 were combined in a single group and their average age at menarche was compared to that of those girls born after 1960.

Results

The occurrence of menarche according to season and month of occurrence are graphed together in Figure 1. In general, the frequency of menarche rises in the spring, reaches a maximum in the summer months and then declines in the fall and winter months. There is a sharp peak in the midsummer months, particularly July, and a lesser peak in the winter

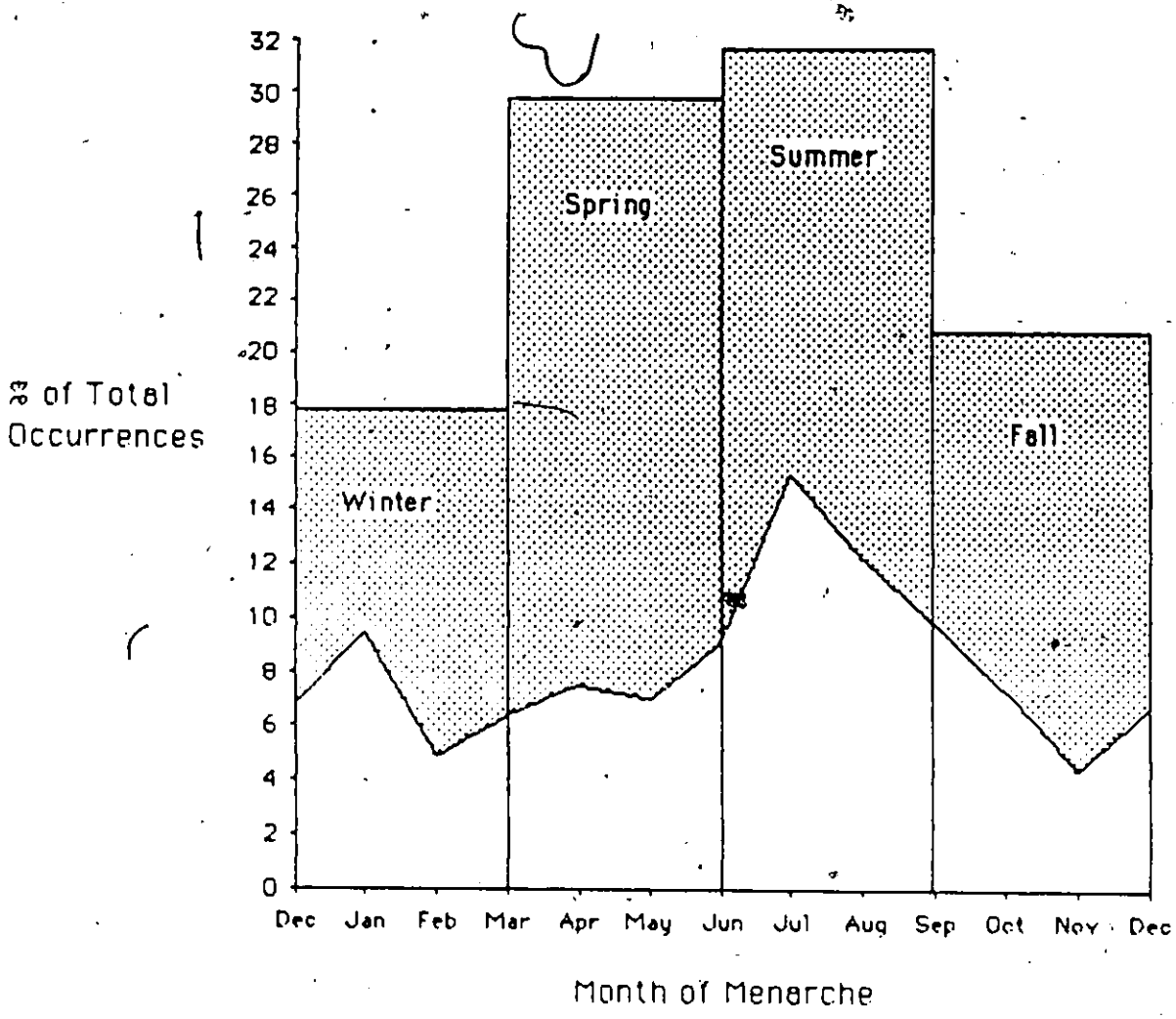


Figure 1 Seasonal variation in the occurrence of menarche. The hatched bars represent the percentage of girls reporting menarche according to season (N= 1,163) The points on the line represent the percentage of girls reporting the occurrence of menarche by month (N=614).

months of December and January. A χ^2 test performed on the frequency of menarche across seasons was significant ($\chi^2(3, N=1,163)=60.98, p\leq.0001$). Over one half of the respondents were able to recall the month of the occurrence of menarche as well as the season. When these cases were examined separately the seasonal variation in month of menarche was also highly significant ($\chi^2(11, N=614)=78.24, p\leq.0001$). While the girls reporting menarche in the spring tended to be slightly older (by approximately one month) than those reporting that menarche occurred in the other months, this difference was not significant (Table 9). A comparison of the seasonal distribution of menarche in women born prior to or after 1960 reveals that there has been no significant shift in the seasonal peak of menarche (Table 10).

Table 11 compares the average age at menarche in women born before and after 1960. In contrast to the usual findings regarding year of birth and age at menarche, women born before 1960 experienced menarche on average just over four months earlier than those born after 1960 and this difference was significant. To examine this finding in more detail, the analysis was repeated, this time comparing the age at menarche of women born in each decade (participants born between 1910-1929 were combined because of their small number). The results of this analysis suggest that menarcheal age declined between 1910 and 1950's but then increased after 1960 (Table 12).

Discussion

Menarche, in this sample, exhibited seasonal variation with spring and summer maxima, and a trough in fall and winter. These results closely approximate those reported for several American populations (Cages & Riley, 1970; Zacharias, Wurtman & Schatzoff, 1970) and those for a sample of Finnish girls (Kantero & Widholm, 1971a). Although season of

Table 9. The mean age at menarche (yrs) according to the season in which it occurred.

	Spring	Summer	Fall	Winter
Menarche	13.05	12.96	12.97	12.96
SD	1.26	1.30	1.44	1.22
n	338	357	239	205

$F(3,1135) = 0.36$, $p = .78$

Table 10. Comparison of the seasonal distributions of menarche in women born from 1910-1959 and those born after 1960. Values in the top row are the actual numbers and values in parentheses represent the percentage of women experiencing menarche in each season.

	Spring	Summer	Fall	Winter
1910-1959	66 (32)	63 (31)	47 (21)	35 (16)
1960+	274 (29)	300 (32)	197 (21)	173 (18)

$\chi^2(3) = .95$, $p = .81$

Table 11. Comparison of the mean age at menarche (yrs) of women born before and after 1960.

	Before 1960	After 1960
Menarche	12.81	13.05
SD	1.39	1.30
n	237	961

$F(1,1196) = 6.16, p \leq .01$

Table 12. Comparison of the mean age at menarche (yrs) according to a woman's year of birth.

	1910-1929	1930-1939	1940-1949	1950-1959	1960+
Menarche	13.58	13.01	12.71	12.74	13.05
SD	1.41	1.07	1.35	1.52	1.31
n	12	38	92	95	961

$F(4,1193)=2.97, p \leq .02$

menarche was not associated with the age at which puberty occurred, these results are consistent with the hypothesis that the occurrence of menarche is affected by light and temperature cycles. A comparison of the seasonal distribution of menarche of women born before and after 1960 suggested that only minor changes occurred during this time.

A secular decline in the age at menarche has been observed in many countries (Tanner, 1962). Therefore, the finding that the average age of menarche in women born since 1960 was later than that of women born prior to 1960 is particularly interesting. Other authors have reported a deceleration in the secular decline, or a stabilization of the age of menarche, but I believe this is one of the first reports suggesting a reversal in the secular decline. By controlling for both environmental and genetic variation, comparing menarcheal age for successive generations within families may be the best test for secular changes. An examination of the difference between mothers' and daughters' menarcheal ages in Survey II provides additional support for a reversal of the secular decline: Mothers matured on average one month earlier than their daughters.

Since the number of women in this sample born prior to 1960 was relatively small and the sample was not random, it is possible that sampling procedures may account for the relationship between year of birth and menarcheal age. As mentioned in Chapter 1, older women have more difficulty remembering the age at menarche and therefore the data from women born in the early part of this century may be less reliable than those from women born later. Nevertheless, this report represents one of the first indications of the occurrence and subsequent reversal of the secular decline in the age at menarche.

CHAPTER 5. FAMILY COMPOSITION AND THE TIMING OF MENARCHE

Exposure to conspecifics influences the timing of female reproductive maturity in many mammalian species. Although it appears that other aspects of the human menstrual cycle may be influenced by social interactions (Chapter 1), the possibility that human menarche may be influenced by such factors has not been adequately examined. This chapter represents the first detailed North American report on the relationship between family composition and the timing of human menarche.

Exposure to conspecifics and the timing of puberty in non-humans

Many mammals alter the timing of puberty as a result of exposure to conspecifics. For example, puberty is accelerated in female house mice exposed to unrelated adult males or their odours (Vandenbergh, 1969) and is delayed by exposure to adult females in crowded conditions (Drickamer, 1976) and in litters containing two or more littermates (Drickamer, 1974). In prairie dogs, first ovulation is delayed in females who remain in contact with their sires (Hoogland, 1982). Similarly, female voles who cannot disperse from their burrows due to high population density delay puberty (Lidicker, 1980). In house mice, the effects of adult conspecifics appear to be moderated by primer pheromones which alter the maturation of the female reproductive system (Vandenbergh, Whitsett & Lombardi, 1975). Littermate effects, however, may be the result of exposure to intra-uterine androgen emanating from male fetuses (vom Saal & Bronson, 1980). While it is unlikely that such prenatal effects occur in humans, due to singleton births, it is possible that chemical cues emanating from siblings postnatally may influence girls' development.

While there is not yet a clear consensus as to the pattern of these effects and species differences remain, it appears that effects of conspecifics on female puberty may vary depending on the degree of relatedness or familiarity between the individuals involved. For instance, exposure to related males tends to inhibit reproductive maturity while exposure to unrelated males accelerates development and hastens estrus. Maturational delays in the presence of closely related or familiar males may be part of an adaptive suite of techniques that females employ to prevent inbreeding. For example, Hoogland (1982) suggested that prairie dogs employ both physiological and behavioural means to avoid extreme inbreeding. Daughters are less likely to come into estrus if their father remains in their coterie, and if they do go into estrus they avoid mating with closely related males and seek out unrelated males with which to copulate.

Studies of social grouping and the age at female maturity in New World monkeys (e.g. marmosets and tamarins) suggest that some primate species may employ analogous techniques of inbreeding avoidance. Marmosets and tamarins are unusual in that they are primarily monogamous and live in nuclear families where males actively contribute to the care of offspring (see Jolly, 1985). Reproduction appears to be inhibited or delayed in some species of New World monkeys when juvenile females remain in family groups. For example, in some marmoset species only one female in a family or in a group of unrelated females is reproductive, regardless of the number of females present. Upon removal from the group, female offspring and subordinate females generally become reproductive (Rothe, 1975). Whether non-reproduction in subordinates or female offspring was behaviourally or physiologically inhibited could not be established without hormone assays, as estrus is not advertised in such species. For example, Tardif (1984) tested the hypothesis that non-reproductive cotton-top tamarin females in family groups are physiologically inhibited or

anovulatory by housing juvenile females with unrelated adult males or in natal groups and employing hormone assays to detect first ovulation. He detected the onset of ovarian cyclicity in both groups but found that females raised with unrelated adult males began cycling significantly earlier than those remaining with their families. However, it was not possible to determine from these results whether group differences were due to the presence of an unrelated male or due to remaining in the family group, or both. Moreover it appeared that the presence of a healthy or reproductive mother in the family group was not related to the daughters' age at maturation: The age at maturation in females raised in family groups where mothers were ill, non-reproductive or dead before daughters matured did not differ significantly from females raised with healthy, reproductive mothers.

Similar studies of social grouping and onset of ovarian cycles involving hormonal essays in other marmoset and tamarin species have produced conflicting results. Epple and Katz (1983) demonstrated that juvenile saddle-back tamarins did not experience estrous cycles while housed in family groups. Abbott and Hearn (1978) found that some daughters in family groups of common marmosets cycled while Evans and Hodges (1984) found no evidence of ovarian cyclicity in females of the same species housed in family groups. Evans and Hodges admit that because ovulation is irregular in young animals it is possible that some may have ovulated sporadically. Nevertheless, females removed from family groups showed evidence of cyclicity within twenty days after isolation.

If some marmoset and tamarin females do cycle in their natal family groups they usually do not conceive. Rothe (1975) reported that common marmoset females actively reject the sexual advances of their brothers. Tardif (1984) suggests that behavioural inhibition of mating with fathers and brothers may occur and Abbott (1984) suggests that familiarity or an "incest taboo" may prevent males from mating with ovulatory daughters. Therefore, it appears

that in some monkey species physiological inhibition may reduce the occurrence of inbreeding and where physiological inhibition is incomplete or absent, behavioural tactics may decrease the probability of inbreeding.

Aggressive and dominance interactions with other females may also result in non-reproductivity. In many species only the dominant females in social groups reproduce. For example, Wasser (1975) demonstrated that subordinate female yellow baboons harrassed by dominant females delay first reproduction. Lunn (1978) reported that common marmoset females who are behaviourally dominant show consistent ovarian cycles while subordinate females do not. Physical or psychological harrassment by dominant females may result in the loss of cyclicity in subordinate females or in the resorption or abortion of embryos. Therefore a common assumption in some previous studies is that the suppression of first ovulation in female offspring in family groups occurs because of the dominance of the mother. The dominant status of mothers likely influences these effects in some species. However, the findings of Tardif (1984) question whether the presence of the mother in a family group is necessary for delayed ovulation in daughters, or whether other individuals or characteristics of the family group may be involved.

Human family composition and menarche

Although alterations in female maturity according to social grouping in non-human mammals do not exhibit consistent patterns and the underlying mechanisms are not fully understood, it has been suggested that analogous effects exist in humans. For example, in light of the existing non-human literature, Burger and Gochfeld (1985; Chapter 3) suggested that a change in the pheromone environment due to changing patterns of exposure to mothers and fathers in family settings may have influenced the secular decline in the age at human

menarche. In the past few decades, the proportion of time spent with mothers versus fathers may have changed as men have become more involved in childraising and women's roles outside the family have expanded. Jenicek and Demirjian (1974) found that there was no significant difference in age at menarche in girls whose mothers stayed at home versus those whose mothers worked outside the home.

Girls may now spend less time with both parents, because of the increased opportunities to associate with individuals outside the home provided by urbanization and mass transportation. Young women in modern urban centres are less isolated from peers than they might have been in traditional rural communities. Brown (1966) suggested that increased psychosexual stimulation may be related to early menarche, but Tanner (1967) has discounted this hypotheses, citing studies which have shown no difference in menarcheal age between girls raised in all-female boarding schools versus those attending coed schools. Nevertheless, Damon et al. (1969) speculated that the effect of urbanization may be analogous to the acceleration of development observed in wild rats raised in the laboratory setting and that psycho-social factors cannot be dismissed as a possible influence on early menarche. More recently, Adams (1981) has echoed Brown's (1966) earlier suggestion that increased stimulation may be involved in the earlier age at menarche and cites the early maturation of city girls as evidence for his thesis.

Draper and Harpending (1982) reviewed the voluminous classical developmental and psychoanalytic literatures concerning the effects of parental absence, especially father absence, on children's development and proposed another hypothesis regarding the relationship between family composition and age at menarche. The classical literatures on father absence are based on western cultures where it is the norm for children to be raised by both parents and have led to the somewhat biased expectation that loss of a male role model leads to defects in

sex-role formation and behaviour problems. However, in some cultures, it is customary for fathers to have little or only indirect input in childraising. Paternal investment varies both within and across cultures and the expectation of psychological deficits in father-absent children surely reflects an ethnocentrism of western psychologists. It is unlikely that selection would have created an ontogeny so fragile that it could result in whole populations of children exhibiting "psychological deficits". It is much more likely that children have evolved appropriate mechanisms which permit the development of competency in a number of different environmental conditions. The observed variability in paternal investment coupled with the notion that children may adaptively respond to levels of perceived paternal investment has led Draper and Harpending (1982) to suggest that alternative reproductive strategies may be employed by children in high versus low paternal involvement environments.

They suggest that the perception of different cultural scenarios in early childhood may set developmental trajectories and that "children show evolved, sensitive-period learning in early childhood which is linked to mother's pairbond status or to mother's attitude toward males"(Draper & Harpending, 1982, p.255). In particular, girls who perceive early in life that males are unreliable sources of parental investment and resources will adopt a strategy which involves early childbearing without the careful selection of a reliable mate. On the other hand, girls who perceive males as reliable providers and active participants in childcare, will adopt a strategy in which childbearing is delayed to facilitate the finding of a reliable and nurturant mate. Barkow (1984) expanded this hypothesis and suggested that in addition to adopting these two different behavioural strategies, girls should also mature at different rates.

Draper and Harpending suggest that psychological factors, such as attitudes towards males, may underlie the choice of strategy and that girls who have negative views of males and distrust males may be more likely to adopt a strategy of early childbearing and reduced

parental investment. They base this claim on Hetherington's (1972) finding that father-absent girls whose parents divorced tended to be more sexually precocious and flirtatious than those whose fathers had died. Draper and Harpending suggest that girls who experienced father absence due to divorce will have negative attitudes toward males while girls whose fathers had died may tend to idealize the father role. Therefore more negative views of men may underlie the relationship of father absence and sexual precocity and explain why girls whose fathers died were more like those who had remained with both parents continuously.

In formulating their hypothesis, Draper and Harpending have borrowed the concept of alternative reproductive strategies from evolutionary biologists. Within some species, it appears that two alternative phenotypes with different behavioural routes to reproductive success have evolved. For example, among bluegill sunfish two alternative male morphs coexist (Gross & Charnov, 1980). "Parental" males are large, build nests and establish territories to which they attract females to spawn. "Sneakers" are small and when they are young dart into the nests of parental males and fertilize eggs. When they grow older they become female mimics (so as not to provoke attacks) and enter the spawning territories of males in attempts to fertilize eggs. There is some evidence that in some species, females also exhibit bimodality in life history traits (Clark, Spencer & Galef, 1986).

The notion of alternative strategies assumes that under specific conditions those individuals who adopt them will have higher reproductive success than those who do not. That is, such strategies must be evolutionarily stable and able to resist invasion by other strategies. As an alternative to Draper and Harpending's hypothesis, one could argue that where male parental investment is high and increases offspring survival females with such a reliable mate should produce as many offspring as early as possible. This argument, however, assumes that females need not invest any time in finding such mates and that there is little within-species

variance in male parental investment. If not all males in the population invest equally in offspring and if the acquisition of the most reliable males requires additional time then females should delay reproduction until such time as they have found such a mate. However, if the proportion of reliable mates in the population is very low, then a female could delay forever, and never reproduce. If the proportion of reliable mates is high, then only a little time will elapse before one is found. This would result in females in the first case delaying reproduction for long periods of time or indefinitely and females in the second case delaying reproduction for short periods of time, which is the opposite result to that predicted by Draper and Harpending.

But assume that in the population where most males invest very little in childcare that a few females decide to forego looking for a permanent and reliable mate and just begin reproducing as soon as physiologically possible. Very quickly they would outreproduce those that waited. In populations where most males invest in childcare but some do more than others a tradeoff will occur between mate search time and offspring production and an optimal period of waiting will evolve. It is possible that within species or populations there may be segments of the population where the proportion of parental males may be greater or less than in other segments. Therefore, if females can detect the proportion of parental versus nonparental males early in life they may be able to adjust the timing of reproduction so as to be optimal in that environment. One of the cues could be the amount of male parental care they themselves accrued. Therefore, those girls growing up in conditions of low male parental involvement may infer that the proportion of parental males in the population is low and begin reproduction without waiting for a highly parental mate. The opposite may occur in girls growing up in conditions of high-paternal investment.

Therefore, Draper and Harpending's hypothesis, though speculative, is not incompatible with the notions of alternative strategies. Moreover, it does provide testable hypotheses and

has recently received some empirical support (Blain & Barkow, 1988). The value of Draper and Harpending's hypothesis for the present research is that (coupled with Barkow's (1984) expansion) it suggests; (1) father absence may be associated with certain reproductive behaviours (and possibly early menarche); (2) the timing of reproduction (and menarche) may be related to psychological factors, such as attitudes toward males and ; (3) variation in reproductive behaviours (and menarche) according to family circumstances may reflect adaptive responses on the part of females.

At the time Barkow (1984) extended Draper and Harpending's ideas he was not aware of any direct tests of the hypothesis that human family composition, particularly parental absence, may be related to the timing of menarche. Indirect evidence suggests that father-absence may be associated with early menarche. Studies of female delinquency (promiscuity) and teenage pregnancies often implicate a "broken home" as a factor (Barglow, Bornstein, Exum, Wright & Vissotsky, 1968; Cowie, Cowie & Slater, 1968; Friedman, 1969). Since the onset of sexual activity tends to be correlated with the age at menarche (Presser, 1978; Udry, 1979), this indirectly suggests that early menarche may be associated with "broken homes". Moreover, blacks in the United States have an earlier average age at menarche than whites and are more likely to live in homes without fathers than are whites (Adams, Milner & Schrepf, 1984; MacMahanon, 1973). Therefore, there is some reason to suspect that parental absence; particularly father absence, may be associated with the timing of menarche.

I have been able to locate only one published study which directly investigated the relationship of family composition and menarche. Jones, Leeton, McLeod and Wood (1972) interviewed 400 women in a Melbourne Hospital. Fifteen percent of these women reported that their fathers were absent at the time of menarche. Of these women, those who had experienced

the absence of their father before six years of age matured significantly earlier than those whose fathers remained until menarche. In addition, Jones et al. found that an increasing number of brothers, but not sisters, was associated with a later menarche. This association was apparently due to the number of younger brothers, as the number of older brothers was not significantly related to the age at menarche. These authors did not report the average age at menarche in father-present versus father-absent groups, nor the magnitude of the difference between the two groups, nor did they mention the type of statistical tests employed in the analysis. Neither did they examine these groups in terms of height, weight, family size or socioeconomic differences, although they mentioned that most women came from a lower socioeconomic group. Therefore, it is impossible to determine whether their findings could be attributed to nutrition, other socioeconomic or psychological factors, or sheer physical exposure to a father. Moreover because the magnitude of the difference between the two groups is not stated it is impossible to evaluate the biological or psychological significance of their findings. For example, a difference of two weeks in the age at menarche in father-absent versus father-present girls may be statistically significant and interesting, but it is questionable whether such a difference would be important in the lifespan of a woman. The present chapter therefore examines the relationship of family composition and the age at menarche in considerably more detail and in light of other possible relevant variables.

Methods

All the female participants in both surveys were divided into four groups: women who had lived with both genetic parents continuously, women who had experienced the absence of a genetic mother premenarcheally, those who had experienced the absence of a genetic father before menarche and those who had experienced the absence of both parents, either sequentially

or because they were adopted. Girls who had experienced short parental absences of less than six months duration were not considered to have experienced parental absence unless they occurred on a chronic or ongoing basis (e.g. father worked on an offshore fishing vessel every summer while the girl was growing up). The average age at menarche in each of these groups was compared by means of Mann-Whitney U pairwise comparisons. Non-parametric tests were used because violations of the assumptions of homogeneity of variance and normality were accompanied by extremely unequal sample sizes and small subsamples ($\leq$ 20 cases). The level of significance for these planned comparisons was adjusted to control for family-wise error by the modified Bonferroni technique (Keppel, 1982) and was set at $p \leq .03$.

Participants were divided into groups according to whether they had zero, one or two or more brothers or sisters. The separate influence of number of brothers versus number of sisters on the timing of menarche was determined by a two-way analysis of variance.

Results

Of the 1,247 women who completed a questionnaire, 204 or 16 % were raised in families where parental absence had occurred prior to menarche. A comparison of the average age of menarche in girls from different family types revealed that girls who experienced the absence of a father or the absence of both parents matured 4-5 months earlier than those who lived with both parents continuously and seven months earlier than those who had experienced the absence of the mother only (Table 13). Moreover, the age at menarche was positively and significantly correlated with the number of years spent with a father until ten years of age ($r(1115) = .13, p \leq .001$). Mother-absent girls had an average age at menarche over 2 months later than girls who lived with both parents continuously, but this difference was not significant. The age at menarche in father-absent girls and girls who had experienced the

Table 13. Comparison of the mean age at menarche (yrs) in girls from families of different composition.

Family composition (n)	M ± SD	Comparison (Mann-Whitney U)	p-value
Both parents present (925)	13.07 ± 1.31	vs. Mother absent	.16
		vs. Father absent	.002
		vs. Both parents absent	.02
Mother absent (20)	13.25 ± 1.67	vs. Father absent	.02
		vs. Both parents absent	.03
Father absent (142)	12.71 ± 1.29	vs. Both parents absent	.53
Both parents absent (36)	12.69 ± 1.31		
Sequential (10)	13.01 ± 1.78		
Adopted (26)	12.56 ± 1.15		
Total (1123)	13.02 ± 1.32		

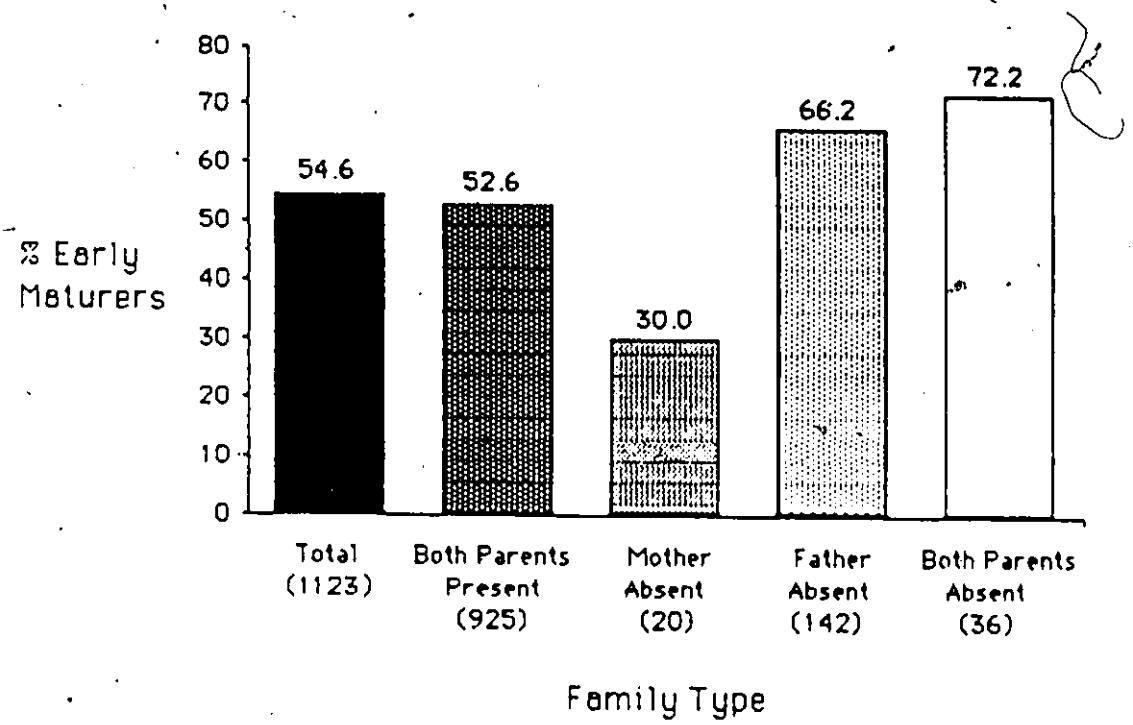


Figure 2 The percentage of girls maturing at or before the median age at menarche (13.00 years) in different family types. Sample sizes in each group are given in parentheses

absence of both parents was not significantly different. Examination of the proportion of early maturers or those falling below the median age of menarche (13.00 years) provides a clear picture of the differences between the groups (Figure 12). Both groups in which father absence occurred contained a higher proportion of early maturers than the group living continuously with both parents or those who experienced the absence of their mothers.

To determine if women raised with both parents and those who experienced the absence of a father only differed significantly in any other ways, these two groups were compared according to family size, birth order, weight, height, Quetelet Index, SES and life events inventory (Table 14). The two groups did not differ significantly on any of the socioeconomic variables. However, father-absent girls received significantly higher scores on the life events inventory than those raised with both parents continuously.

In light of the above findings the two-way analysis of variance on the number of brothers and sisters was calculated excluding parent-absent groups to remove any possible effects of father-absence. The analysis indicated that neither number of brothers nor number of sisters was significantly associated with the age of menarche (Table 15).

Discussion

These results suggest that human family composition, particularly the presence or absence of parents, is related to the timing of menarche. In this sample, father-absent girls and girls who experienced the absence of both parents were especially early maturers. Father-absent girls, however, did not differ from girls in two parent families according to social class, family size, birth order, height, weight or Quetelet index. Therefore socioeconomic differences between these two groups do not seem to account for the observed difference in age at menarche. As discussed in Chapter 3, these socioeconomic variables

Table 14. Comparison of girls who lived with both parents continuously and those who experienced the absence of a father only ($M \pm SD$, ns are given in parentheses).

	Both parents present	Father absent	p-value* (t-test)
Family size	3.10 ± 1.32 (943)	3.12 ± 1.62 (146)	.89
Birth order	2.08 ± 1.31 (912)	2.12 ± 1.60 (136)	.77
Weight	58.93 ± 9.03 (271)	58.96 ± 8.9 (68)	.98
Height	165.54 ± 6.84 (274)	165.78 ± 5.62 (68)	.79
Quetelet Index	21.48 ± 2.73 (271)	21.45 ± 3.14 (68)	.94
Socioeconomic Index	50.16 ± 16.30 (883)	49.79 ± 16.06 (104)	.83
Life events Index	131.70 ± 97.33 (939)	274.85 ± 162.82 (138)	.0001

* based on separate variance t-value, except for Socioeconomic index, as variances were unequal.

Table 15. Mean age at menarche in girls growing up with both parents present according to number of brothers and sisters ($M \pm SD$, ns are given in parentheses).

	Number of brothers*			
Number of sisters**	0	1	2+	Total
0	12.96 ± 1.24 (31)	12.98 ± 1.35 (164)	13.04 ± 1.20 (116)	13.00 (311)
1	13.04 ± 1.21 (139)	13.17 ± 1.49 (159)	12.89 ± 1.31 (74)	13.07 (367)
2+	13.12 ± 1.36 (104)	13.26 ± 1.30 (84)	13.10 ± 1.37 (54)	13.16 (242)
Total	13.06 (269)	13.11 (407)	13.01 (244)	13.07 (920)

*Main effect of Brothers: $F(2,911) = .98$, $p = .38$
** Main effect of Sisters: $F(2,911) = .72$, $p = .49$

generally account for only a small proportion of the variance in the age of menarche in this sample, although they have been shown to be more important in other populations.

The finding of a relationship between exposure to fathers and the age at human menarche is analogous to the effects in non-human mammals discussed earlier. One explanation of these findings, derived from the animal literature, is that the presence of related or familiar adult males may delay puberty via a chemical signal or pheromone. Conversely the presence of an unrelated, unfamiliar male may be related to an acceleration in the age at menarche. This possibility must be considered as there is some evidence that primer pheromones may be involved in human menstrual synchrony and in the increase in cycle regularity when women have regular sexual partners (Cutler et al., 1986; Preti et al. 1986; Russell, Switz & Thompson, 1980).

One possible way to test the hypothesis that the presence of an unfamiliar, unrelated male accelerates puberty while the presence of a familiar, related male delays puberty is to compare the age at menarche in girls who had step fathers enter the home after the absence of their father to those who did not. Just over one third of father-absent girls reported that a step-father entered the home after the absence of their father but prior to menarche. The average age at menarche in father-absent girls who had a step-father enter the home before menarche was compared to those who did not. Girls with step-fathers matured almost two months earlier than girls without step-fathers but this difference was not statistically significant (Table 16). Therefore, these results are in the direction one would predict according to the hypothesis that the presence of an unfamiliar or unrelated male accelerates menarche, but are not statistically significant.

If physical presence of a father, or exposure to his odours, underlies the relationship between father absence and early menarche, then the age at which father absence occurred may

Table 16. Mean age at menarche in father-absent girls who had stepfathers versus those who did not.

	Stepfather	No Stepfather
Mean	12.60	12.75
SD	1.08	1.37
n	37	103

F (1,138) = .32, p=.53 (Brown-Forsythe)

Table 17. Comparison of the mean age at menarche in father-absent girls according to the age at which father absence occurred.

	Age at which father absence occurred		
	Birth - 4 yrs	5-9 yrs	10 yrs +
Menarche (yrs)	12.61	12.57	13.39
SD	1.17	1.36	1.39
n	(54)	(61)	(24)

F= 3.66 (2, 136), p= .03 (Brown-Forsythe)

Table 18. Comparison of the mean age at menarche in girls with father absence due to different causes.

	Divorce	Death	Other (work,illness)
Menarche (yrs)	12.66	12.84	13.07
SD	1.27	1.62	0.76
n	113	20	7

Kruskall-Wallis test statistic (2)=1.78, p = .41

be related to the timing of menarche. If physical presence of a father inhibits sexual maturity then girls who experienced father absence at an early age might be expected to have an earlier age at menarche than those who experienced father absence later on. To examine this possibility all women experiencing father-absence were then divided into three groups according to the age at which father-absence occurred. The mean age at menarche of girls whose fathers left the home before ten years of age was approximately ten months earlier than those whose fathers left after they reached ten years of age. Therefore girls who experienced father-absence before ten matured on average six months earlier than girls who were raised with both parents continuously (Table 17). These results support the hypothesis that the physical presence of a father somehow inhibits girls' development but do not rule out other psychological mediators that may also be related to the age at which father absence occurred.

For example, girls who experienced father absence at an early age may have more distant relationships with their fathers or may have more negative views of men than girls whose fathers left after a considerable period of involvement. To separate the effects of physical exposure from such psychological variables it would be necessary to examine girls who experienced the physical absence of their fathers without perhaps the emotional trauma and distancing that often accompany abandonment, divorce or death. A number of respondents did not indicate that they had experienced father-absence in the family composition section of the questionnaire, but did indicate in the life events section that their father had been away from home because of work. These women possibly experienced the physical absence of their fathers, without the conflict and emotional upheavals that usually accompany parental divorce or death. (Some fathers may have chosen to take work out of town because of marital problems, but conflict may still be assumed to be lower in this group than in those where a divorce actually occurred.) The age at menarche in girls who were not categorized as father-absent but

who reported reduced exposure to their fathers because of work (13.17 yrs) versus those who lived with both parents continuously (13.07 yrs) was not significantly different ($t(53)=.68$, $p=.50$). On one hand, this suggests that sheer physical exposure to a father does not totally account for the difference in age at menarche between father-absent and father-present girls. On the other hand, this may not be an adequate test because girls with father absence due to work may have experienced the physical absence of a father for only very short durations compared to girls whose fathers had died or divorced. Unfortunately, where father-absence due to work was indicated on the life events inventory, no information on the duration or extent of father-absence was available. Nevertheless, I believe that women in this group probably experienced only short and possibly insignificant periods of absence, because those who experienced longer periods of absence indicated this in the family composition section of the questionnaire and were coded as father-absent. (As discussed in a following section, the small number of father-absent girls whose fathers were absent due to seasonal work (e.g. fishing) or whose fathers had been hospitalized for long periods of time tended to mature close to the average age and were not early maturers (Table 18)). Therefore while it appears that the age at which father absence occurred is related to the timing of menarche, it is unclear whether physical presence of the father per se or other "psychological" concomitants underlie the relationship between father-absence and early maturity.

Draper and Harpending suggested that psychological factors such as attitudes toward males and the father role may be important determinants in the "strategy" adopted by a particular girl. Girls who experience father absence because of divorce may have more negative attitudes towards males than girls whose fathers died and may be more likely to adopt a strategy of early reproduction. In particular, Barkow's expansion of this hypothesis predicts that menarche may be earlier in girls who experience father-absence due to divorce versus

death. To examine this possibility the average age at menarche was compared in women who experienced father absence due to divorce, death or for other reasons (hospitalization, out-of-town work)(Table 18). Women who reported that father-absence occurred because of divorce matured on average two months earlier than girls whose fathers had died and five months earlier than those whose fathers were absent for other reasons. While these results are in the direction predicted by extending Draper and Harpending's hypothesis (Barkow, 1984), these differences were not significant. Nevertheless, the possibility that mothers' attitudes toward males may be involved in the relationship between early menarche and father absence cannot be ruled out. Moreover, as discussed in a later section and in the next chapter, other characteristics of divorced mothers (e.g. age at menarche) could also influence daughters' age at menarche.

Cross cultural studies have suggested that stressful childhood events are associated with early menarche (Whiting, 1965). Indeed in this sample, "stress", as defined by scores on a life events inventory, was negatively and significantly correlated with the age at menarche (r (1104)= -.14, $p \leq .001$). Girls who experienced high levels of stress while they were growing up matured earlier than those who did not. Therefore, acceleration of puberty in response to stress is a possible explanation of the relationship between father absence and early menarche, as parental separation and death are undoubtedly stressful life events. Father-absent girls scored significantly higher on the life events inventory than girls growing up in the continual presence of both parents. Years of exposure to a father before ten years of age was negatively and significantly correlated with the total score on the life events inventory (r(1127)=-.31, $p \leq .0001$) and positively correlated with the age at menarche (r(1115)=.13, $p \leq .001$). Father-absent girls may represent the most "stressed" end of the population distribution and it is possible that "stress" underlies the relationship between

father absence and early menarche. On the other hand the correlation between life events score and years spent with a father is possibly due to the inclusion of many items in the stress inventory that are direct or indirect measures of father absence (e.g., death of a parent, marital separation, divorce, increase in arguments between parents, change in parents' financial status). When a partial correlation was performed to remove the effects of stress from the correlation between puberty and years of exposure to a father the correlation was slightly reduced but remained significant ($r(1115)=.09$, $p\leq.004$). Therefore, score on the life events inventory and years of exposure to a father may be partially redundant measures, but still contribute separately to the age at menarche. Another way to separate the effects of "stress" from those of father-absence is to examine the relationship of life events score with the age at menarche in the group of women who grew up with both parents only. The correlation between life events score and the age at menarche when all parental absence groups are removed from the calculation remains significant ($r(913)=-.09$, $p\leq .01$). Moreover the median test comparing "low stress" and "high stress" groups described in Chapter 3 also remains significant when parental absence groups are removed.

The age at menarche did not differ significantly in girls who experienced father absence versus those who experienced the absence of both parents. These two groups, however, did differ in other ways and there is some reason to believe that the source of early maturity in each of these groups may have differed (Table 19). Girls who experienced the absence of both parents reported significantly lower scores on the life events inventory than girls in the father-absent group but did not differ significantly from girls raised with both parents. A large proportion (72%) of girls with both parents absent were adopted shortly after birth. This explains why girls in this group compared to the group experiencing only the absence of a father came from significantly smaller families and differed in birth order and the age at which

Table 19. Comparison of the general characteristics of father-absent girls with girls who experienced the absence of both parents ($M \pm SD$, ns are given in parentheses).

	Father absent	Both parents absent	Bonferroni Significance Level
Age father absence occurred	5.64 ± 4.40 (140)	1.00 ± 3.33 (35)	.001
Family size	3.12 ± 1.62 (146)	2.47 ± 1.26 (19)	.01
Birth order	2.12 ± 1.60 (136)	1.37 ± 1.67 (30)	.05
Weight	58.96 ± 8.97 (68)	55.80 ± 8.54 (10)	n.s.
Height	165.78 ± 5.62 (68)	164.80 ± 4.39 (10)	n.s.
Quetelet Index	21.45 ± 3.14 (68)	20.51 ± 2.72 (10)	n.s.
Socioeconomic Index	49.88 ± 16.06 (104)	53.21 ± 20.30 (11)	n.s.
Life events Index	274.85 ± 162.83 (138)	178.47 ± 160.76 (36)	.001

father absence occurred. It is very likely that many of these girls were the products of teenage mothers who themselves had been early maturers, as early maturers are at risk of early pregnancy. Therefore, heritability of the age at menarche may largely account for the lower age at menarche in adoptees.

Many authors have reported positive and significant relationships between early menarche, early sexual behaviour, early first births, early marriage, shorter birth spacing, higher fertility, increased fecundity and lower educational attainment (e.g. Cristescu, 1975; Furstenberg & Crawford, 1980; McAnarney & Thiede, 1983; Presser, 1978; Trussel & Menken, 1978; Udry, 1979; Udry & Cliquet, 1982; Waite & Moore, 1978; Westoff & Ryder, 1977). Furthermore, early marriages and marriages enacted to legitimize births are more likely to break down than those occurring later (Adams, Milner & Schrepf, 1984; Freedman, Thornton & Wallish, 1981; Furstenberg & Crawford, 1980). Therefore, women who are early maturers may be more likely to divorce. Since the age at menarche is heritable, these women may also be more likely to produce daughters who are themselves early maturers and more likely to be father-absent by virtue of their mothers' higher probability of divorce. Mother's age at menarche therefore may also largely account for the early age at menarche observed in father-absent girls, as it probably does in adoptees. While heredity may be an important factor in the relationship between father absence and early maturity, additional parental influences, such as liberal or conservative views toward heterosexual relationships and attitudes toward the family and males, could also be involved. The possibility that both hereditary and psychological factors contribute to the early age at menarche observed in father-absent girls is examined in the following chapter.

CHAPTER 6. PARENTAL INFLUENCES ON THE TIMING OF MENARCHE

Parental characteristics, such as height, weight and age at puberty, and other psychological attributes, may influence the timing of menarche. This chapter explores hereditary and psychological influences (parental attitudes) on menarche in an attempt to understand further the relationship between early menarche and father absence. A multiple regression analysis is employed to determine how much of the variance in the age at menarche can be accounted for by the variables identified in this study. The following questions were investigated:

1. Are a daughter's menarcheal age, height, weight and Quetelet index correlated with her parents' indices of puberty, height, weight and Quetelet index?

2. Are daughters' and parents' attitudes toward males, the family and dating (heterosexual relationships) correlated and are these attitudes related to daughter's age at menarche?

3. How do father-absent girls and their mothers differ from father-present girls and their mothers? Does the reason for the absence of a father (death versus divorce) matter?

4. How much of the variance in the age at menarche is accounted for by the factors examined in this research?

Hereditary influences on menarche

Johnston (1974) suggested that 10-15 % of the total variance in menarcheal age may be explained by heredity. Studies of the concordance between female relatives in the age at menarche show that the closer the genetic relationship, the greater the concordance. A significant and positive correlation between mothers' and daughters' menarcheal ages has been reported in various populations: a correlation coefficient of .28 was reported in a study of 1,000 Finnish mother/daughter pairs (Kantero and Widholm, 1971b); Damon et al. (1968)

reported a coefficient of .24 in a small sample of American women; and Popenoe (1928, cited in Tanner, 1962) reported a coefficient of .40 in a study involving 351 mother/daughter pairs. Sisters' ages at menarche are also highly correlated (e.g. r=.39 (Popenoe, 1928) and r=.40 (Boas, 1932). Tisserand-Perrier (1953, cited in Tanner, 1962) found that while sisters' ages at menarche differed on average by 13 months and fraternal twins differed by one year, identical twins differed by only 3 months. Fischbein (1977) also reported a much higher concordance between monozygotic twins (2-3 months difference) than between dizygotic twins (9 months difference).

Genetic inheritance of early maturity may play a role in the relationship between father absence and early menarche. For instance, it is possible that either one or both parents of father-absent girls were themselves early maturers. Most studies of genetic influences on menarche have involved only female relatives, although Tanner (1962) suggested that it is just as likely that the age at menarche is inherited from the father as from the mother. However, depending on the method of transmission, this may or may not lead to concordance in pubertal ages of fathers and daughters. For example, if daughters inherit a general rate of development from their fathers that affects both male and female development similarly, then a correlation may exist between indices of puberty in fathers and daughters. However, if a father transmits a gene to his daughter that only affects female target organs, then a correlation between daughter's and father's puberty will not be evident.

Parental attitudes and psychological influences on the timing of menarche

The significant negative relationship between life events score and the age at menarche, described in Chapter 3, is consistent with the idea that psychological factors may influence the age at maturation. Moreover, high levels of stress are both associated with early menarche and

contribute to the difference in maturity observed between father-absent and father-present girls (Chapter 6). However, variation in life events score does not completely account for the difference in menarcheal age between these groups and it is possible that other psychological factors could be involved. While conducting longitudinal studies of children's development Steinberg (1988), found that "psychological distance" between daughters and fathers was a good predictor of menarcheal age and that the greater the distance, the earlier the menarche. His sample, however, consisted of a high proportion of stepfather/daughter pairs. If we assume that girls are less close to stepfathers than to natural fathers, then his measure of "psychological distance" may just be another measure of father absence. One way to test this would be to remove father-absent girls from his sample to determine if a significant relationship between menarche and "psychological distance" remains. Moreover, although this relationship was discovered in the context of a longitudinal investigation, the direction of causation remains tentative. Nevertheless, Steinberg's research represents one of the first explorations of how psychological influences within the family may alter the timing of maturity.

Furthermore, as discussed in the preceding chapter, Draper and Harpending (1982) suggested that mother's attitudes toward males may mediate the relationship between developmental strategy and father involvement and that girls' perceptions of men may be colored by their mothers' attitudes. They suggested that father-absent girls will be mistrustful of males and may engage in early childbearing without carefully selecting a suitable mate. Such girls and their mothers may have rather cynical views of men and the traditional family in general. They may also have less traditional and conservative attitudes toward dating and premarital relationships. Moreover, Draper and Harpending suggest that girls whose fathers have died may resemble father-present girls more than girls whose parents have divorced. Therefore, to investigate Draper and Harpending's hypothesis, the attitudes of girls and their

mothers were compared between the father-present and father-absent groups in the present study, and between those father-absent girls who experienced that absence because of death versus divorce.

Methods

All analyses in this chapter were computed on information obtained from the 248 questionnaires returned in the second survey only: 131 were completed by daughters, 89 by mothers and 28 by fathers. Of the questionnaires returned by daughters, 69 were completed by girls who grew up in homes with both parents continuously, 49 by father-absent girls, 3 by mother-absent girls, 8 by girls who reported both parents were absent and 2 could not be categorized because of missing information. As few girls experienced the absence of their mothers or both parents, these groups were not included in the analyses.

Correlations between the pubertal measures, physical attributes and attitudes of daughters and their parents were conducted on all possible daughter-parent pairs. Because some parents who completed questionnaires had more than one daughter participating in the survey, the number of parent-daughter pairs was greater than the total number of parents participating. A discussion of the attitude scales which measured attitudes toward males, dating and the family are found in chapter 2 (General Methods). The reproductive characteristics and attitude scores of mothers and daughters in both father-present and father-absent homes were compared by *t*-tests. Mothers and daughters from homes where father-absence occurred due to death versus divorce were similarly compared.

Furthermore, a multiple regression analysis was conducted to determine the amount of variance in the age at menarche accounted for by the variables examined in this study.

Results

CORRELATIONS BETWEEN DAUGHTERS' AND PARENTS' PUBERTAL MEASURES AND PHYSICAL CHARACTERISTICS.

Correlations between daughters' and parents' pubertal indices and other physical characteristics are given in Table 20. The average age at menarche among daughters was 12.92 ± 1.16 years and among mothers, 12.87 ± 1.40 years. A daughter's menarcheal age was significantly correlated with her mother's menarcheal age, weight and Quetelet index. The average ages at which fathers reached adult height and began shaving were 16.26 ± 1.40 and 15.12 ± 1.30 years, respectively. A daughter's age at menarche was not significantly correlated with either measure of father's development, nor with his height, weight or Quetelet index, although an increase in the number of fathers involved may have produced significant results. Unfortunately, it was not possible to distribute questionnaires to any fathers of father-absent girls because many of the girls were no longer in contact with their fathers or their fathers had died. This means that most of the correlations were calculated only with fathers who remained continuously with their daughters. Therefore, some restriction in the range of possible values may have occurred and depressed the value of the resulting correlations.

CORRELATIONS BETWEEN DAUGHTERS' AND PARENTS' ATTITUDES

Daughters' and mothers' attitudes toward males, dating and the family were positively and significantly correlated. Fathers' and daughters' attitudes toward males, but not toward dating or the family, were positively and significantly correlated. Neither parent's attitude scores were significantly correlated with daughter's menarcheal age (Table 21).

Table 20. Correlations between daughters' and parents' pubertal measures and other physical characteristics (the number of mother-daughter pairs = 93-102, father-daughter pairs = 29-35)

	Daughter's			
	Menarche	Height	Weight	Quetelet index
Mother's				
Menarche	.27**			
Height	.04	.53**		
Weight	-.27**	--	.32**	
Quetelet index	-.29**	--	--	.27**
Father's				
Age began shaving	-.04			
Age attained adult height	-.13			
Height	.10	.45**		
Weight	-.16	--	.33*	
Quetelet	-.26	--	--	.31

* $p \leq .05$, ** $p \leq .01$

Table 21. Correlations between daughters' and parents attitudes toward males, dating and the family (the number of mother-daughter pairs = 102-110, father-daughter pairs = 33-39)

	Daughter's Attitudes			
	Menarche	Males	Dating	Family
Mother's Attitudes				
Males	.02	.49**		
Dating	.01	--	.52**	
Family	-.12	--	--	.36**
Father's Attitudes				
Males	-.30	.50**		
Dating	.21	--	.28	
Family	.09	--	--	-.04

* $p \leq .05$, ** $p \leq .01$

COMPARISONS OF FATHER-ABSENT AND FATHER-PRESENT GIRLS AND THEIR MOTHERS

Father-absent girls and father-present girls and their mothers differed in a number of important ways (Table 22). The average age at menarche of girls who experienced the absence of their fathers (12.70 ± 1.21) was 4.75 months lower than that of those girls who did not (13.08 ± 1.33). With this small sample size this difference was not statistically significant, although it was of similar magnitude to that found in Survey I. On average, father-absent girls dated one month earlier than father-present girls, but this difference was not significant. The average age at menarche of the mothers of father-absent girls (12.64 ± 1.39) was 6.5 months lower than among father-present girls (13.16 ± 1.26) and this difference was marginally significant. In addition to differences in menarcheal age, mothers of father-absent girls began dating at a significantly earlier age and tended to have more children beginning at an earlier age than the mothers of father-present girls.

Father-absent girls and their mothers viewed men significantly more negatively than father-present girls and their mothers. The mothers of father-absent girls had significantly more negative views of the family than the mothers of father-present girls. The two types of daughters did not differ significantly on this measure, but there was a strong trend in the same direction. Mothers in father-absent homes did not differ from father-present mothers, nor did father-absent daughters differ from father-present daughters in attitudes toward dating. Father-absent girls had significantly higher scores on the life events inventory than did father-present girls.

If mother's menarcheal age accounts for the early age at menarche in father -absent girls, then removing the effect of mother's menarche from the comparison of father-absent and father-present girls should reduce the differences between the two groups. Therefore, the difference between mothers' and daughters' ages at menarche for each group was calculated and

Table 22. Comparison of several characteristics of daughters and mothers in families where both parents had lived continuously or where father absence had occurred.

	Both parents present	Father absent	
	M ± SD (n)	M ± SD (n)	p-value (t-test)
Daughters' menarche	13.08 ± 1.33 (66)	12.70 ± 1.21 (47)	.12
Daughters' age at first date	14.56 ± 1.53 (61)	14.46 ± 1.54 (40)	.77
Daughters' attitude toward males	-6.08 ± 5.24 (67)	-8.53 ± 5.20 (49)	.01
Daughters' attitude toward dating	48.33 ± 9.01 (69)	49.22 ± 10.78 (49)	.63
Daughters' attitude toward the family	9.10 ± 11.34 (69)	5.18 ± 13.23 (49)	.09
Daughters' life events score	133.68 ± 109.98 (66)	307.49 ± 179.12 (47)	.0001
Mothers' menarche	13.16 ± 1.27 (58)	12.64 ± 1.39 (41)	.06
Mothers' age at first date	15.83 ± 2.00 (61)	14.95 ± 1.42 (42)	.02
Mothers' age at first child	24.74 ± 3.58 (61)	23.67 ± 4.29 (42)	.17
Mothers' number of children	2.75 ± 1.31 (61)	3.29 ± 1.60 (42)	.07
Mothers' attitude toward males	-7.84 ± 6.13 (57)	-12.07 ± 6.21 (42)	.001
Mothers' attitude toward dating	38.16 ± 9.52 (61)	39.7 ± 7.87 (40)	.39
Mothers' attitude toward the family	12.95 ± 8.35 (60)	8.69 ± 9.15 (42)	.02

Table 23. Comparison of several characteristics of daughters and mothers in families where father absence had occurred due to the death of the father or because of divorce.

	Death	Divorce	
	M ± SD (n)	M ± SD (n)	p-value (t-test)
Daughters' menarche	13.21 ± 1.96 (5)	12.62 ± 1.14 (40)	.31
Daughters' age at first date	16.40 ± 1.14 (5)	14.25 ± 1.42 (38)	.002
Daughters' attitudes toward males	-8.60 ± 3.78 (5)	-8.50 ± 5.50 (42)	.98
Daughters' attitude toward dating	44.60 ± 5.68 (5)	50.10 ± 10.52 (42)	.26
Daughters' attitude toward the family	6.00 ± 16.72 (5)	4.33 ± 12.60 (42)	.78
Mothers' menarche	13.89 ± 1.97 (5)	12.50 ± 1.27 (34)	.04
Mothers' age at first date	16.22 ± 1.98 (5)	14.79 ± 1.25 (35)	.03
Mothers' age at first child	26.97± 5.10 (5)	23.33 ± 4.11 (35)	.08
Mothers' number of children	2.91 ± 1.27 (5)	5.40 ± 2.19 (35)	.0006
Mothers' attitudes toward males	-6.00 ± 4.5 (5)	-13.20 ± 5.96 (35)	.01
Mothers' attitudes toward dating	33.00 ± 5.34 (5)	40.42 ± 7.85 (33)	.05
Mothers' attitudes toward the family	11.60 ± 8.41 (5)	8.40 ± 9.26 (33)	.47

father-absent and father-present groups compared by t-test. The two groups did not differ significantly ($t(92)=.74$, $p \leq .46$). However, this may not have been an adequate test, as the small sample involved in this comparison may have reduced the probability of detecting differences. Moreover, the reversal in the secular decline in menarcheal age, as evidenced by mothers having a lower age at menarche than daughters (Chapter 4), may have reduced the effects of father absence. Furthermore, this analysis does not take any other variables correlated with mothers' or daughters' ages at menarche into account.

For example, in addition to being correlated with mother's age at menarche, daughters' age at menarche was marginally correlated with the years she spent with a father until age 10 ($r(118)= .18$, $.05 \leq p \leq .1$) and was highly and negatively correlated to her score on the life events inventory ($r(119)=-.31$, $p \leq .01$). Mother's age at menarche, however, was not significantly correlated with her daughter's scores on the life events inventory ($r(96)=-.15$, $p \geq .1$). When a partial correlation was performed to remove the effects of mother's menarcheal age, the correlation between daughter's menarcheal age and the number of years she spent with her father before until age 10 was reduced to $r=.14$. While this procedure did not greatly reduce the magnitude of the correlation, it was no longer significant for this sample size. Similarly, when a partial correlation was computed to remove the effects of stress from the correlation between daughter's menarche and years spent with a father until the age of ten, the correlation did not decrease greatly in magnitude ($r=.11$), but was no longer significant at this sample size. It is possible that with larger sample sizes both of these correlations would have remained significant.

FATHER ABSENCE DUE TO DEATH VERSUS DIVORCE

The majority of father-absent girls had experienced the absence of their fathers because

their parents had separated or divorced and only a small minority (5) reported the death of a father. The small number of girls in this category substantially reduces the possibility of detecting reliable differences. Nevertheless, the timing of reproductive milestones and the attitudes of girls and their mothers were compared in the two groups (Table 23). Father-absent girls whose fathers had died tended to have an earlier menarche, more conservative views toward dating and more positive views toward the family than did those girls whose parents had divorced, but none of these differences were significant. The two groups of girls did not differ in their attitudes toward males. The mothers of girls whose fathers had died reached menarche significantly later, had significantly more positive views of men and more conservative views toward dating than did the mothers who were divorced or separated. Although mothers who were divorced had more negative views toward the family than mothers whose husbands had died, this difference was not statistically significant. Both daughters whose fathers had died and their mothers began dating significantly later than those who had experienced divorce.

PERCENTAGE OF VARIANCE IN MENARCHEAL AGE ACCOUNTED FOR IN THIS STUDY

A multiple regression analysis was performed to identify those variables which contributed significantly to the regression equation and to determine the total amount of variance in daughter's menarcheal age accounted for by the combination of these variables. Daughter's life events score, mother's Quetelet index, mother's menarcheal age and mother's attitudes toward the family each contributed significantly to the regression equation and together accounted for 23 % of the variance in daughter's menarcheal age, which was a significant portion of the variance ($F(4,84) = 5.37$, $p \leq .0001$).

Discussion

Although father-absent girls and their mothers differed from father-present girls and their mothers on some attitudinal measures, scores on the attitude scales were not significantly correlated with daughters' menarcheal age. However, both mother's age at menarche and daughter's life events score were significantly correlated with daughter's menarcheal age and differed as a function of father absence. This suggests that both mothers' age at menarche and stress influence the early age at menarche in father-absent girls.

The mothers of father-absent girls were themselves early maturers, began dating early, tended to have their first child at an earlier age and had more children than did the mothers of father-present girls. It was not possible to determine the influence of a father's age at puberty on menarche because only a relatively small number of fathers completed questionnaires. Since all fathers had lived with their daughters continuously, a restriction in the range of possible values may have occurred and little can be concluded about a father's genetic contribution to his daughter's menarcheal age.

These results strongly suggest that inheritance of an early menarche from mothers is an important factor in the early menarcheal age of father-absent girls. Moreover, they suggest that early menarche is associated with a cluster of social and sexual behaviours that are related to a woman losing her mate or never living with the father of her child. Numerous other authors have reported relationships between early menarche, early sexual experience, pregnancy and low scholastic achievement (Hetherington, 1972; Udry, 1979; Waite & Moore, 1978). Early biological maturity may put a woman "at risk" for early pregnancy and early pregnancy may decrease a woman's opportunity to find a compatible and trustworthy mate. Thus an early maturing woman may be more likely both to undergo divorce or loss of a mate and to produce early maturing daughters. In turn, her daughters may be both early maturers and

father-absent and predisposed to repeat their mother's life cycle. Although I do not have information on the family composition of the mothers involved in this study, several women who called mentioned that they were the second or third generation of women in the family to raise their children single-handedly.

A daughter's life events score was significantly correlated with her age at menarche and the number of years she spent with her father before menarche. Therefore it appears that while mother's menarcheal age is undoubtedly an important factor, it may not be the only variable accounting for the early age at menarche in father-absent girls. Attempts to assess the contribution of either of these variables to the difference in menarcheal age between father-absent and father-present groups were inconclusive. A much larger sample size may be necessary to separate the effects of stress from those of mother's menarche, and to determine their relative contributions to the age at menarche in general and to the difference in menarcheal age observed between father-present and father-absent girls. For the present, it seems likely that the "effects of father absence" are entirely the result of maternal characteristics transmitted to daughters which happen to be correlated with (or causal to) father absence.

The multiple regression analysis revealed that the combined factors of daughter's life events score, mother's Quetelet index, mother's menarcheal age and mother's attitudes toward the family accounted for a significant proportion of the variance in daughter's menarcheal age. While the proportion of variance explained may be greater than that accounted for in many previous studies (e.g. Roberts & Dann, 1967) 77% of the variance in the timing of menarche was still not accounted for by the variables examined in this study.

CHAPTER 7. SUMMARY

Menarche is an important milestone in the life history of the human female and its timing has been shaped by a history of natural selection. Humans differ from other mammals, and to a lesser extent from other primates, in that menarche occurs at the end of an adolescent growth spurt. Menarche is followed by a period of adolescent subfertility during which an extraordinary increase in fat deposits occurs before fertility is achieved.

Humans are a highly social, large-brained species in whom the development of social competence depends on a long period of postnatal parental investment. At birth a human infant's brain is immature and continues to grow well into the second decade of life. The storage of fat and the attainment of adult stature prior to first conception may allow more energy to be converted to the infants' growing brain via extended periods of lactation. In many mammals, where the mother does not reach adult size until after the birth of the first litter, gestation and lactation may be seen as competing with maternal growth. Therefore, in humans it appears that the attainment of adult size prior to fertility may be a necessary prerequisite for the successful rearing of altricial young.

The period of adolescent subfertility allows for the reorganization of self-image and priorities in preparation for childbirth and childraising. It also permits time for the establishment of social networks and alliances and the preparation of a social situation conducive to the raising of offspring. In particular, it allows for a period of sexual experimentation and the finding of a compatible and reliable mate to help in the raising of offspring.

The menarche, like other aspects of female physiology, is sensitive to aspects of the

social and physical environment. Although social interactions with individuals appear to alter other aspects of the menstrual cycle (Chapter 1) there has been little empirical investigation into the relationship between contact with certain individuals and menarcheal age.

The primary goal of this research was to investigate the relationship between family composition and menarcheal age, although a number of other variables were also examined. As described in Chapter 2, two surveys, involving 1,314 participants, were conducted between 1984 and 1987 to gather retrospective data regarding the onset of menarche, socioeconomic status, height, weight, family composition, seasonality of menarche, stress and attitudes. The average age at menarche in this population, which was in accord with other estimates for central Canada, was several months later than the average age reported for girls in the United States and was closer to the mean age reported for British girls.

The occurrence of menarche was highly seasonal with the highest frequencies occurring in the spring and summer months, particularly in July. Curiously, the age at menarche appeared to have declined in women born in the 1940s and 50s compared to those born earlier, but then increased in women born after 1960 (Chapter 4). Most socioenvironmental factors that have been reported as affecting menarcheal age in other populations, such as socioeconomic status and family size, were not significantly related to the timing of menarche in this sample. General health and nutritional differences probably underlie reported socioeconomic differentials in menarcheal age in some populations. In this sample, weight per height was weakly correlated with the age at menarche (Chapter 3) but this finding did not seem to translate into socioeconomic differences. Canadian society is not as stratified as some of the developing countries in which socioeconomic effects are found, and this may explain why such variables exerted little influence on menarche. In addition, this sample was relatively advantaged, as most participants involved in this research were university students, so a

restriction in the range of socioeconomic classes may have reduced the probability of finding socioeconomic effects. Lack of socioeconomic effects may have facilitated the examination of more subtle influences.

The most interesting finding was that girls who experienced premenarcheal father absence matured on average 4.5 months earlier than those who lived with both parents continuously. Moreover, father-absent girls whose parents had divorced or who had experienced father absence before ten years of age matured 5-6 months earlier than girls growing up with both parents. Neither absence of the mother nor the number of brothers and sisters appeared to be related to the timing of menarche (Chapter 5).

Life events score, a measure of "stress", was significantly and negatively correlated with menarcheal age. Moreover, father-absent girls had significantly higher "stress" scores than did girls who lived with both parents continuously. High levels of stress in father-absent girls may partially account for the early menarche observed in this group, but a significant correlation between menarcheal age and years spent with a father before age 10 remains when the effects of stress are partialled out. The fact that most girls who experienced the absence of both parents (most of whom where adopted) had not experienced increased levels of stress, but were early maturers, suggested that hereditary factors may also be involved in the relationship between early menarche and father absence.

Chapter 6 reported a significant correlation between mothers' and daughters' ages at menarche. Moreover, the mothers of father- absent girls tended to be early maturers, dated early, had early first births and had more negative views of men than the mothers of father-present girls (Chapter 6). Early maturity appears to be associated with a cluster of reproductive and social behaviours, including divorce. It thus appears that hereditary factors in conjunction with high levels of stress may largely account for the early age at menarche in

father-absent girls. The finding that stress is related to menarcheal age is consistent with the the hypothesis that "psychological" variables may be involved in the timing of menarche. A number of authors have speculated that psychological factors may be related to the timing of menarche, but this suggestion has remained essentially untested. The possibility that simple physical exposure to a father may influence a daughter's development through some kind of chemical cue can not yet be ruled out, as there is some evidence that the timing of father-absence is related to the age of menarche in father-absent girls. For the present, it is doubtful whether exposure to a father has any direct effects on female maturation, the highly significant differences between father-present and father-absent girls notwithstanding.

Nevertheless, these findings contribute to our knowledge about the timing of menarche in several ways. First of all, on a practical and immediate level, they identify a group of girls particularly at risk for early pregnancy, as early maturation is a contributing factor to early pregnancy. Early marriages (some of which are enacted to legitimize a premarital conception) are less stable than those that occur at a later age. One could speculate that partners who enter into an early marriage, especially those following a premarital conception, have acted hastily and only later realize that they are incompatible. Another possibility is that women who marry early and are early maturers may be less attractive in the long run to males because of their lower educational attainment or their greater weight per height.

Secondly, the finding that early maturity and father-absence are linked and seem to be perpetuated through generations may help to explain a number of disparate observations in the demographic, psychological and social work literatures such as: (a) father-absent girls have been observed to be sexually precocious; (b) female juvenile delinquents, a large percentage of whom are "sexually delinquent", are more likely to have come from "broken homes" than non-delinquent girls; and (c) black women in the United States generally have a lower age at

menarche and are more likely to have experienced father-absence than whites.

A third contribution of this study involves the demonstration that the addition of information regarding family composition and other psychological variables, such as stress, in future studies of menarcheal age may improve our ability to explain the timing of menarche. While the variables examined in this research account for more of the variance in menarcheal age than has been done in many previous studies, a substantial proportion (77%) of the variance remains unexplained.

Finally, this research emphasizes the importance of viewing menarche from a broader comparative perspective and suggests several avenues for future investigation of the biosocial influences on the timing of human menarche.

APPENDIX A

1. Birthdate _____

2. Please indicate in years and months, if possible, the age you were when you first menstruated.

   _____years_____months ☐ I have not yet menstruated
   ☐ I cannot remember at all

3. What season of the year did your first menstruation occur in? If you can remember the exact month please write it in the space next to the appropriate season.

   ☐ spring (March-May _____
   ☐ summer (June-Aug.)_____
   ☐ fall (Sept.-Nov.) _____
   ☐ winter (Dec.-Feb.) _____

4. Did you have any severe illnesses, accidents or operations from birth until you reached the age of 15 years? If so, please describe and indicate how old you were when these occurred.

5. In the space provided please indicate:

   1) the birthdate of all the children living in your household while you were growing up until you reached the age of 15 years
   2) their relationship to you, e.g., brother, sister, half brother, adopted sister, cousin
   3) their sex (if not apparent from (2) above)
   4) the period of time each child resided with you with reference to your age during that time, e.g., my half brother lived with me until I was 5 years old and then he left home

Child	Birthdate	Relationship	M/F	Period of residence with you
EXAMPLE	Jan. 10, 1946	sister	-	left home when I was ten
1				
2				
3				
4				
5				

6 In the space provided please indicate:

1) all the adults that lived in your household while you were growing up until you reached age 15 years and their relationship to you, e.g., natural mother, stepfather, adoptive mother, grandfather (father's father), friend
2) their sex (if not apparent from (1) above)
3) the main occupation of each of these adults (please be as specific as possible, e.g., 'high school teacher' instead of 'teacher')
4) the period of time each adult resided with you with reference to your age during that time, e.g., my parents were divorced when I was 10 years old and my mother left the household at that time

Adult	Relationship	M/F	Occupation	Period of residence with you
EXAMPLE	natural mother	-	nurse (R.N.)	birth until present
1				
2				
3				
4				

7. Please recheck your answer to question 2 on the first page. It is very important that your answer be as accurate as possible. After rechecking your answer please check the box below which corresponds to how close you believe your answer is to your actual age at first menstruation.

☐ within one month ☐ within three months ☐ within six months
☐ within nine months ☐ within twelve months ☐ over twelve months difference

8. At the time of your first menstruation, which of the statements below best describes how you felt about the timing of this event?

☐ wished it had started later, when I was a bit older
☐ wished it had started earlier, when I was a bit younger
☐ didn't have any preference for when menstruation first started

9. Below are some descriptions of different kinds of communities in which people live. In the space to the right of each age category place the number of the description which best describes the type of community you lived in during these times.

(1) Large metropolitan: contains city of 500,000 or more, many suburbs, very little open country
(2) Medium metropolitan: contains city of 150,000 to 499,999, several suburbs,

some open country

(3) Small metropolitan: contains city of 50,000 to 149,999, few suburbs, considerable open country

(4) Semi-urban: contains city 10,000 to 49,999, few smaller towns, much open country

(5) Semi-rural: contains city of 2,500 to 9,999, one or two smaller towns, mostly open country

(6) Rural: contains town of less than 2,500, surrounded entirely by open country

Age: (a) birth to 5 years _____
(b) 6 to 10 years _____
(c) 11 to 15 years _____

10. Listed below are a number of important events which a person sometimes experiences in the course of his or her lifetime. Please circle those events below which you experienced in the period from birth to 15 years of age. Then in the space(s) on the right please indicate how old you were (to the best of your memory) when this event occurred. If the event occurred more than once please indicate how old you were each time the event occurred.

	Age(s)		
1) Beginning to date	____	____	____
2) Outstanding personal achievement	____	____	____
3) Breaking up with a boyfriend	____	____	____
4) Increase in number of arguments with parents	____	____	____
5) Beginning junior high school	____	____	____
6) Brother or sister leaving home	____	____	____
7) Decrease in number of arguments with parents	____	____	____
8) Suspension from school	____	____	____
9) Not making an extracurricular activity you wanted to be involved in	____	____	____
10) Becoming a full fledged member of a church	____	____	____
11) Death of a grandparent	____	____	____
12) Death of a close friend	____	____	____
13) Increase in number of arguments between parents	____	____	____
14) Becoming a victim of sexual abuse	____	____	____
15) Becoming involved with drugs or alcohol	____	____	____
16) Mother beginning to work	____	____	____
17) Decrease in number of arguments between parents	____	____	____
18) Change in parents' financial status	____	____	____
19) Move to a new school district	____	____	____
20) Serious illness requiring hospitalization of parent	____	____	____
21) Serious illness requiring hospitalization of a brother or sister	____	____	____
22) Failure of a grade in school	____	____	____
23) Change in your acceptance by peers	____	____	____
24) Becoming a victim of physical abuse	____	____	____
25) Change in father's occupation requiring increased absence from home	____	____	____
26) Pregnancy in unwed teenage sister	____	____	____
27) Birth of a brother or sister	____	____	____

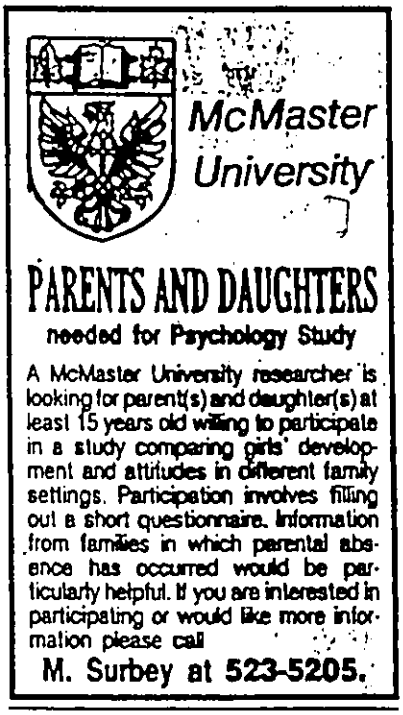
28) Divorce of parents	____	____	____
29) Addition of third adult to family	____	____	____
30) Serious illness requiring hospitalization	____	____	____
31) Marital separation of parents	____	____	____
32) Marriage of parent to step-parent	____	____	____
33) Death of a parent	____	____	____
34) Having a visible congenital deformity	____	____	____
35) Acquiring a visible deformity	____	____	____
36) Loss of job by parent	____	____	____
37) Jail sentence of a parent for 30 days or less	____	____	____
38) Death of a brother or sister	____	____	____
39) Unwed pregnancy	____	____	____
40) Discovery of being an adopted child	____	____	____
41) Becoming a victim of psychological abuse	____	____	____
42) Jail sentence of a parent for 1 year or more	____	____	____
43) Please specify any other events you think should be noted.			
_____	____	____	____
_____	____	____	____

11. When you were growing up until you reached the age of 15 years how true were the following statements about the kinds of pressures that you felt? (circle the number on the right that best corresponds to your experience)

	not at all true	somewhat true	moderately true	considerably true	extremely true
1) I felt pressured to do well at school.	1	2	3	4	5
2) I was encouraged to do well at a particular sport, art or hobby.	1	2	3	4	5
3) I felt pressured to find and succeed at a career.	1	2	3	4	5
4) I was warned not to become sexually active.	1	2	3	4	5
5) I was told that if I became pregnant at an early age it would ruin my chances for an education, career or marriage, etc.	1	2	3	4	5
6) My parents put a lot of emphasis on my achievements.	1	2	3	4	5
7) My parents offered me incentives to get good marks.	1	2	3	4	5
8) I felt I should excel at everything I did.	1	2	3	4	5
9) I was expected to continue my education after graduating from high school.	1	2	3	4	5
10) My parents would often display my trophies, awards, best report cards, assignments or artwork.	1	2	3	4	5

Thank you!

APPENDIX B



McMaster University

PARENTS AND DAUGHTERS

needed for Psychology Study

A McMaster University researcher is looking for parent(s) and daughter(s) at least 15 years old willing to participate in a study comparing girls' development and attitudes in different family settings. Participation involves filling out a short questionnaire. Information from families in which parental absence has occurred would be particularly helpful. If you are interested in participating or would like more information please call

M. Surbey at 523-5205.

PARENTS AND DAUGHTERS A researcher in the Psychology Department is looking for parents and daughters (15 years and older) willing to participate in a study comparing girls' development and attitudes in single and two parent families. Participation involves parent(s) and daughter(s) filling out a short questionnaire. This research will expand our current knowledge about the effects of different family experiences on girls' development and attitudes and your participation would be greatly appreciated. A small remuneration ($1) will be given to each family member who participates. If you are interested in participating or would like more information please call 523-5205 or leave a message at the Psychology General Office 525-9140 (ext. 3000) for M. Surbey.

Survey is for girls in family

I am a doctoral student in the psychology department at McMaster University. Several weeks ago I wrote in looking for families with daughters (15 or older) to participate in a survey of girls' development in different family settings.

I received many responses, some from remote areas of Ontario, and would like to thank all of the readers who called and volunteered to participate in my survey.

However, my survey is not yet complete and if any other families are interested in participating I would welcome their calls at 416-523-5205 (collect). I am especially interested in hearing from families in which a parental absence, death or divorce occurred.

Michele K. Surbey
Department of Psychology
McMaster University
Hamilton, Ont.

Doctoral student seeks families

I am a doctoral candidate in the psychology department at McMaster University and am looking for parents and daughters (over 15 years of age) willing to participate in a study comparing girls' development and attitudes in single and two-parent families.

Participation involves parent(s) and daughter(s) filling out a short questionnaire which is then returned to me via postage-paid envelopes.

If your family is interested in participating, please call me (collect) in Hamilton at (416)523-5205.

Michele K. Surbey
Hamilton, Ont.

APPENDIX C

QUESTIONNAIRE A: MOTHERS: Please answer these questions carefully and in as much detail as possible. It is very important that you recall dates and events as accurately as possible. In order to assist your memory try to recall any significant occurrences e.g., first day of high school, a family vacation, that happened around the date in question. Please feel free to add any comments or qualifications to your answers.

PERSONAL AND DEVELOPMENTAL INFORMATION

Q-1 Birthdate ___/___/___ Height _____ Weight _____
Day/Month/ Year (Please specify ft, ins, lbs, cms or kgs)

Q-2 When you were growing up did you suffer from any illnesses or accidents that might have affected your rate of growth? If so, please describe and indicate how old you were when these occurred.

Q-3 How old were you when you had your first menstrual period? Please give your age in years and months, if possible (e.g. 13 years 1 month).

_____years_____months ☐ I cannot remember at all

Q-4 What season of the year did your first menstrual period occur in? If you can remember the exact month please write it in the space next to the appropriate season.

☐ spring (March-May) _____ ☐ fall (Sept-Nov) _____
☐ summer (June-Aug) _____ ☐ winter (Dec-Feb) _____

Q-5 Thinking back to your adolescent years and comparing your physical development to that of your friends and peers would say that, in general, you were an early maturer, average maturer or late maturer?

☐ early maturer ☐ average maturer ☐ late maturer

Q-6 How old were you when you first began dating? Please give your age in years and months, if possible (e.g. 14 years 1 month). _____years_____months

FAMILY COMPOSITION

Q-7 In the space provided please list all your children, indicating their relationship to you, (e.g. natural daughter, stepson, adopted son), their sex and birthdate. Please note which of your daughter(s) have filled out a questionnaire for this survey.

	Child and his/her relationship to you	F/M	Birthdate	Completed a questionnaire? (Yes/No)
EXAMPLE	natural daughter	F	Jan 1, 1967	Yes
1				
2				
3				
4				
5				
6				
7				

ATTITUDES TOWARD FAMILY LIFE AND FAMILY MEMBERS

Q-8 Following is a list of statements that deal with your feelings about family life and the behaviour of certain family members. You may have one of five reactions to each statement. You may strongly agree (5), agree (4), be undecided (3), disagree (2), or strongly disagree (1). Please read each statement carefully and circle quickly whichever of these choices best describes how you currently feel.

	STRONGLY AGREE	AGREE	UNDECIDED	DISAGREE	STRONGLY DISAGREE
1 Home is the most pleasant place in the world.	5	4	3	2	1
2. Parents expect too much from their children.	5	4	3	2	1
3 One ought to discuss important plans with the members of their family.	5	4	3	2	1
4. Every young person should be allowed to choose their dating partner freely and independently.	5	4	3	2	1
5 In making plans for the future, parents should be given first consideration	5	4	3	2	1
6 A person should be willing to sacrifice anything for their family	5	4	3	2	1
7 Parents too often expect their grown-up children to obey them	5	4	3	2	1
8 Girls should be allowed to ask boys for dates.	5	4	3	2	1
9 Boys of 12 should be allowed to date.	5	4	3	2	1
10 Girls of 12 should be allowed to date.	5	4	3	2	1
11 One cannot find as much understanding at home as elsewhere	5	4	3	2	1
12 One owes their greatest obligation to their family.	5	4	3	2	1
13 It is hard to keep a pleasant disposition at home.	5	4	3	2	1
14 Adult supervision for first dates between 12 and 14 is unnecessary.	5	4	3	2	1
15. Boys and girls between 14 and 16 should be allowed to date without any adult supervision.	5	4	3	2	1
16. People in the family can be trusted completely.	5	4	3	2	1
17 One becomes nervous at home.	5	4	3	2	1
18 The joys of family life are much over-rated.	5	4	3	2	1

	STRONGLY AGREE	AGREE	UNDECIDED	DISAGREE	STRONGLY DISAGREE
19 One's parents usually treat one fairly and sensibly	5	4	3	2	1
20 Boys of 14 should be allowed to go steady.	5	4	3	2	1
21 Girls of 14 should be allowed to go steady	5	4	3	2	1
22 It is all right for a young dating couple to park on a lonely road	5	4	3	2	1
23 One should confide more fully in members of their family	5	4	3	2	1
24 One feels most contented at home.	5	4	3	2	1
25 Family ties are strengthened when times are hard.	5	4	3	2	1
26 It is not important for a person to remain pure until marriage.	5	4	3	2	1
27 It is all right for a boy to invite a girl to his home when no one is there	5	4	3	2	1
28 It is all right for a girl to invite a boy to her home when no one is there.	5	4	3	2	1
29 Parents are inclined to be too old-fashioned in their ideas	5	4	3	2	1
30 Members of the family are too curious about one's personal affairs	5	4	3	2	1
31 Parents keep faith in their children even though they cannot find work	5	4	3	2	1
32 Persons between 15 and 18 do not have to inform their parents where they will be while dating.	5	4	3	2	1
33 Dating couples between 18 and 20 should be allowed to stay out as late as they wish	5	4	3	2	1
34 Parents are too particular about the kind of company one keeps	5	4	3	2	1
35 Obligations to one's family are a great handicap to a young person today	5	4	3	2	1
36 When two young people are serious about each other, it is all right for them to make any kind of love.	5	4	3	2	1
37 So far as ideas are concerned, parents and children live in different worlds.	5	4	3	2	1

Q-9. Based on your own experience, please indicate (by marking the appropriate box) whether each of the following statements best characterizes men or women or whether the statement equally characterizes men and women. Please respond to every statement and mark only one box per statement.

	BEST CHARACTERIZES		
	Men	Women	Men & Women Equally
1 Have the most understanding of the real needs of children	☐	☐	☐
2. Reliable and dependable	☐	☐	☐
3 Shirks family and personal responsibilities	☐	☐	☐
4 Careless in matters related to personal and household cleanliness	☐	☐	☐
5 Most subject to violent outbursts of temper	☐	☐	☐
6 Most conscientious in preparing for an event or outing	☐	☐	☐
7 Show greatest warmth toward those less fortunate than themselves	☐	☐	☐
8. Most faithful in marriage or romantic relationships	☐	☐	☐
9 Least willing to accept responsibility for actions which affect the happiness of others	☐	☐	☐
10 Reported to give the greatest happiness to other people	☐	☐	☐
11 If in charge of finances, least likely to go dangerously in debt	☐	☐	☐
12 Prone to take advantage of any situation to further their own selfish needs	☐	☐	☐
13 Personal conscience fails to inhibit reprehensible behaviour	☐	☐	☐
14. Most prone to punctuality out of consideration for others	☐	☐	☐
15 Remain most loyal to friends and causes under fire	☐	☐	☐
16. Persons in whom trustworthiness has been found to be highest	☐	☐	☐
17. Most likely to be sensitive to the feelings of others	☐	☐	☐
18 Fundamentally more prone to impose one's will on others	☐	☐	☐
19 Most inconsistent in handling children	☐	☐	☐
20 More likely to make pretenses socially rather than reveal their real attitudes	☐	☐	☐
21 Receive the most satisfaction from family life	☐	☐	☐
22. Offer the most encouragement or support to family members	☐	☐	☐

THANK YOU!

Your participation in this study will provide us with valuable information about the relationship between children's development and family experiences.

QUESTIONNAIRE B: FATHERS: Please answer these questions carefully and in as much detail as possible. It is very important that you recall dates and events as accurately as possible. In order to assist your memory try to recall any significant occurrences e.g., first day of high school, a family vacation, that happened around the date in question. Please feel free to add any comments or qualifications to your answers.

PERSONAL AND DEVELOPMENTAL INFORMATION

Q-1 Birthdate ___/___/___ Height _____ Weight _____
Day/Month/ Year (Please specify ft, ins, lbs, cms or kgs)

Q-2 When you were growing up did you suffer from any illnesses or accidents that might have affected your rate of growth? If so, please describe and indicate how old you were when these occurred.

Q-3 How old were you when you reached your current (adult) height? Please give your age in years and months, if possible (e.g 15 years 1 month).

_____ years _____ months ☐ I cannot remember at all

Q-4 How old were you when you first began shaving, or if you grew a beard, how old were you when your beard first appeared? Please give your age in years and months, if possible (e.g. 14 years 1 month)

_____ years _____ months ☐ I cannot remember at all

Q-5 Thinking back to your adolescent years and comparing your physical development to that of your friends and peers would say that, in general, you were an early maturer, average maturer or late maturer?

☐ early maturer ☐ average maturer ☐ late maturer

Q-6 How old were you when you first began dating? Please give your age in years and months, if possible (e.g. 15 years 1 month) _____ years _____ months

FAMILY COMPOSITION

Q-7 In the space provided please list all your children, indicating their relationship to you (e.g. natural daughter, stepson, adopted son), their sex and birthdate. Please note which of your daughter(s) have filled out a questionnaire for this survey.

	Child and his/her relationship to you	Birthdate	Completed a questionnaire? (Yes/No)
EXAMPLE	natural daughter	Jan 1, 1967	Yes
1			
2			
3			
4			
5			
6			
7			

ATTITUDES TOWARD FAMILY LIFE AND FAMILY MEMBERS

Q-8 Following is a list of statements that deal with your feelings about family life and the behaviour of certain family members. You may have one of five reactions to each statement. You may strongly agree (5), agree (4), be undecided (3), disagree (2), or strongly disagree (1). Please read each statement carefully and circle quickly whichever of these choices best describes how you currently feel.

	STRONGLY AGREE	AGREE	UNDECIDED	DISAGREE	STRONGLY DISAGREE
1 Home is the most pleasant place in the world.	5	4	3	2	1
2 Parents expect too much from their children.	5	4	3	2	1
3 One ought to discuss important plans with the members of their family.	5	4	3	2	1
4 Every young person should be allowed to choose their dating partner freely and independently.	5	4	3	2	1
5 In making plans for the future, parents should be given first consideration.	5	4	3	2	1
6 A person should be willing to sacrifice anything for their family.	5	4	3	2	1
7 Parents too often expect their grown-up children to obey them	5	4	3	2	1
8 Girls should be allowed to ask boys for dates.	5	4	3	2	1
9 Boys of 12 should be allowed to date.	5	4	3	2	1
10 Girls of 12 should be allowed to date.	5	4	3	2	1
11 One cannot find as much understanding at home as elsewhere	5	4	3	2	1
12 One owes their greatest obligation to their family	5	4	3	2	1
13 It is hard to keep a pleasant disposition at home.	5	4	3	2	1
14 Adult supervision for first dates between 12 and 14 is unnecessary	5	4	3	2	1
15 Boys and girls between 14 and 16 should be allowed to date without any adult supervision.	5	4	3	2	1
16 People in the family can be trusted completely.	5	4	3	2	1
17 One becomes nervous at home.	5	4	3	2	1
18 The joys of family life are much over-rated.	5	4	3	2	1

	STRONGLY AGREE	AGREE	UNDECIDED	DISAGREE	STRONGLY DISAGREE
19. One's parents usually treat one fairly and sensibly.	5	4	3	2	1
20. Boys of 14 should be allowed to go steady.	5	4	3	2	1
21. Girls of 14 should be allowed to go steady.	5	4	3	2	1
22. It is all right for a young dating couple to park on a lonely road.	5	4	3	2	1
23. One should confide more fully in members of their family	5	4	3	2	1
24. One feels most contented at home.	5	4	3	2	1
25. Family ties are strengthened when times are hard.	5	4	3	2	1
26. It is not important for a person to remain pure until marriage.	5	4	3	2	1
27. It is all right for a boy to invite a girl to his home when no one is there.	5	4	3	2	1
28. It is all right for a girl to invite a boy to her home when no one is there.	5	4	3	2	1
29. Parents are inclined to be too old-fashioned in their ideas	5	4	3	2	1
30. Members of the family are too curious about one's personal affairs.	5	4	3	2	1
31. Parents keep faith in their children even though they cannot find work	5	4	3	2	1
32. Persons between 15 and 18 do not have to inform their parents where they will be while dating.	5	4	3	2	1
33. Dating couples between 18 and 20 should be allowed to stay out as late as they wish.	5	4	3	2	1
34. Parents are too particular about the kind of company one keeps	5	4	3	2	1
35. Obligations to one's family are a great handicap to a young person today	5	4	3	2	1
36. When two young people are serious about each other, it is all right for them to make any kind of love.	5	4	3	2	1
37. So far as ideas are concerned, parents and children live in different worlds.	5	4	3	2	1

Q-9. Based on your own experience, please indicate (by marking the appropriate box) whether each of the following statements best characterizes men or women or whether the statement equally characterizes men and women. Please respond to every statement and mark only one box per statement.

	BEST CHARACTERIZES		
	Men	Women	Men & Women Equally
1 Have the most understanding of the real needs of children	☐	☐	☐
2 Reliable and dependable	☐	☐	☐
3 Shirks family and personal responsibilities	☐	☐	☐
4 Careless in matters related to personal and household cleanliness	☐	☐	☐
5 Most subject to violent outbursts of temper	☐	☐	☐
6 Most conscientious in preparing for an event or outing	☐	☐	☐
7 Show greatest warmth toward those less fortunate than themselves	☐	☐	☐
8 Most faithful in marriage or romantic relationships	☐	☐	☐
9 Least willing to accept responsibility for actions which affect the happiness of others	☐	☐	☐
10 Reported to give the greatest happiness to other people	☐	☐	☐
11 If in charge of finances, least likely to go dangerously in debt	☐	☐	☐
12 Prone to take advantage of any situation to further their own selfish needs	☐	☐	☐
13 Personal conscience fails to inhibit reprehensible behaviour	☐	☐	☐
14 Most prone to punctuality out of consideration for others	☐	☐	☐
15 Remain most loyal to friends and causes under fire	☐	☐	☐
16 Persons in whom trustworthiness has been found to be highest	☐	☐	☐
17 Most likely to be sensitive to the feelings of others	☐	☐	☐
18 Fundamentally more prone to impose one's will on others	☐	☐	☐
19 Most inconsistent in handling children	☐	☐	☐
20 More likely to make pretenses socially rather than reveal their real attitudes	☐	☐	☐
21 Receive the most satisfaction from family life	☐	☐	☐
22 Offer the most encouragement or support to family members	☐	☐	☐

THANK YOU!

Your participation in this study will provide us with valuable information about the relationship between children's development and family experiences.

QUESTIONNAIRE C: DAUGHTERS: If you are fifteen years of age or older could you please take the time (10-15 minutes) to fill out this form and return it together with your parents' and sisters' forms or separately in the envelope provided. Try to answer the questions as carefully and in as much detail as possible. It is very important that you recall dates and events as accurately as possible. In order to assist your memory try to recall any significant occurrences e.g., first day of school, a family vacation, that happened around the date in question. Please feel free to add comments or qualify your answers.

PERSONAL AND DEVELOPMENTAL INFORMATION

Q-1 Birthdate ___/___/___ Height _____ Weight _____
Day/Month/Year (Please specify ft, ins, lbs, cms or kgs)

Q-2 When you were growing up did you suffer from any illnesses or accidents that might have affected your rate of growth? If so, please describe and indicate how old you were when these occurred.

Q-3 How old were you when you had your first menstrual period? Please give your age in years and months, if possible (e.g. 13 years 1 month).

_____years_____months ☐ I have not yet menstruated
☐ I cannot remember at all

Q-4 What season of the year did your first menstrual period occur in? If you can remember the exact month please write it in the space next to the appropriate season.

☐ spring (March-May) _____ ☐ fall (Sept -Nov) _____
☐ summer (June-Aug) _____ ☐ winter (Dec -Feb) _____

FAMILY COMPOSITION

Q-5 In the space provided please indicate:

1) the birthdate of all the children living in your household while you were growing up
2) their relationship to you, e.g., brother, sister, half brother, adopted sister, cousin
3) their sex (if not apparent from (2) above)
4) the period of time each child resided with you with refereoce to your age during that time, e g , my half brother lived with me until I was 5 years old and then he left home

Child	Birthdate	Relationship	M/F	Period of residence with you
EXAMPLE	Jan. 10, 1962	sister	F	She lived with me until I was ten, when she left home
1				
2				
3				
4				
5				
6				

Q-6. In the space provided please indicate:

1) all the adults that lived in your household while you were growing up and their relationship to you, e.g., natural mother, natural father, stepfather, adoptive mother, maternal grandfather, family friend
2) their sex (if not apparent from (1) above)
3) the main occupation of each of these adults (please be as specific as possible, e.g., 'high school teacher' instead of 'teacher')
4) the period of time each adult resided with you with reference to your age during that time, e.g., my parents were divorced when I was 10 years old and my father left the household at that time

Adult	Relationship	M/F	Occupation	Period of residence with you
EXAMPLE	natural mother	F	nurse (R.N.)	From my birth until I was 17
1				
2.				
3				
4				

IMPORTANT LIFE EXPERIENCES

Q-7 Listed below are a number of important events which a person sometimes experiences in the course of his or her lifetime. Please circle the number of those events below which you experienced while you were growing up. Then in the space(s) on the right please indicate how old you were (to the best of your memory) when this event occurred. If the event occurred more than once please indicate how old you were each time the event occurred.

	Age(s)
1) Beginning to date	____ ____ ____
2) Outstanding personal achievement	____ ____ ____
3) Breaking up with a boyfriend	____ ____ ____
4) Increase in number of arguments with parents	____ ____ ____
5) Beginning junior high school	____ ____ ____
6) Brother or sister leaving home	____ ____ ____
7) Decrease in number of arguments with parents	____ ____ ____
8) Suspension from school	____ ____ ____
9) Not making an extracurricular activity you wanted to be involved in	____ ____ ____
10) Becoming a full fledged member of a church	____ ____ ____
11) Death of a grandparent	____ ____ ____
12) Death of a close friend	____ ____ ____
13) Increase in number of arguments between parents	____ ____ ____
14) Becoming a victim of sexual abuse	____ ____ ____
15) Becoming involved with drugs or alcohol	____ ____ ____
16) Mother beginning to work	____ ____ ____
17) Decrease in number of arguments between parents	____ ____ ____
18) Change in parents' financial status	____ ____ ____
19) Move to a new school district	____ ____ ____
20) Serious illness requiring hospitalization of parent	____ ____ ____
21) Serious illness requiring hospitalization of a brother or sister	____ ____ ____

	Age(s) cont.		
22) Failure of a grade in school	____	____	____
23) Change in your acceptance by peers	____	____	____
24) Becoming a victim of physical abuse	____	____	____
25) Change in father's occupation requiring increased absence from home	____	____	____
26) Pregnancy in unwed teenage sister	____	____	____
27) Birth of a brother or sister	____	____	____
28) Divorce of parents	____	____	____
29) Addition of third adult to family	____	____	____
30) Serious illness requiring hospitalization	____	____	____
31) Marital separation of parents	____	____	____
32) Marriage of parent to step-parent	____	____	____
33) Death of a parent	____	____	____
34) Having a visible congenital deformity	____	____	____
35) Acquiring a visible deformity	____	____	____
36) Loss of job by parent	____	____	____
37) Jail sentence of a parent for 30 days or less	____	____	____
38) Death of a brother or sister	____	____	____
39) Unwed pregnancy	____	____	____
40) Discovery of being an adopted child	____	____	____
41) Becoming a victim of psychological abuse	____	____	____
42) Jail sentence of a parent for 1 year or more	____	____	____
43) Please specify any other events you think should be noted.			
_____	____	____	____
_____	____	____	____

ATTITUDES TOWARD FAMILY LIFE AND FAMILY MEMBERS

Q-8 Following is a list of statements that deal with your feelings about family life and the behaviour of certain family members. You may have one of five reactions to each statement. You may strongly agree (5), agree (4), be undecided (3), disagree (2), or strongly disagree (1). Please read each statement carefully and circle quickly whichever of these choices best describes how you currently feel.

	STRONGLY AGREE	AGREE	UNDECIDED	DISAGREE	STRONGLY DISAGREE
1 Home is the most pleasant place in the world.	5	4	3	2	1
2 Parents expect too much from their children.	5	4	3	2	1
3 One ought to discuss important plans with the members of their family	5	4	3	2	1
4 Every young person should be allowed to choose their dating partner freely and independently.	5	4	3	2	1
5 In making plans for the future, parents should be given first consideration.	5	4	3	2	1

	STRONGLY AGREE	AGREE	UNDECIDED	DISAGREE	STRONGLY DISAGREE
6 A person should be willing to sacrifice anything for their family.	5	4	3	2	1
7 Parents too often expect their grown-up children to obey them.	5	4	3	2	1
8 Girls should be allowed to ask boys for dates.	5	4	3	2	1
9 Boys of 12 should be allowed to date.	5	4	3	2	1
10 Girls of 12 should be allowed to date.	5	4	3	2	1
11 One cannot find as much understanding at home as elsewhere	5	4	3	2	1
12 One owes their greatest obligation to their family.	5	4	3	2	1
13 It is hard to keep a pleasant disposition at home.	5	4	3	2	1
14 Adult supervision for first dates between 12 and 14 is unnecessary	5	4	3	2	1
15 Boys and girls between 14 and 16 should be allowed to date without any adult supervision.	5	4	3	2	1
16 People in the family can be trusted completely.	5	4	3	2	1
17 One becomes nervous at home.	5	4	3	2	1
18 The joys of family life are much over-rated.	5	4	3	2	1
19 One's parents usually treat one fairly and sensibly	5	4	3	2	1
20 Boys of 14 should be allowed to go steady	5	4	3	2	1
21 Girls of 14 should be allowed to go steady	5	4	3	2	1
22 It is all right for a young dating couple to park on a lonely road.	5	4	3	2	1
23 One should confide more fully in members of their family	5	4	3	2	1
24 One feels most contented at home.	5	4	3	2	1
25 Family ties are strengthened when times are hard.	5	4	3	2	1

	STRONGLY AGREE	AGREE	UNDECIDED	DISAGREE	STRONGLY DISAGREE
26 It is not important for a person to remain pure until marriage.	5	4	3	2	1
27 It is all right for a boy to invite a girl to his home when no one is there.	5	4	3	2	1
28 It is all right for a girl to invite a boy to her home when no one is there	5	4	3	2	1
29 Parents are inclined to be too old-fashioned in their ideas	5	4	3	2	1
30 Members of the family are too curious about one's personal affairs	5	4	3	2	1
31 Parents keep faith in their children even though they cannot find work.	5	4	3	2	1
32 Persons between 15 and 18 do not have to inform their parents where they will be while dating	5	4	3	2	1
33 Dating couples between 18 and 20 should be allowed to stay out as late as they wish.	5	4	3	2	1
34 Parents are too particular about the kind of company one keeps	5	4	3	2	1
35 Obligations to one's family are a great handicap to a young person today	5	4	3	2	1
36 When two young people are serious about each other, it is all right for them to make any kind of love	5	4	3	2	1
37 So far as ideas are concerned, parents and children live in different worlds.	5	4	3	2	1
38 During adolescence I felt pressured to do well at school or make plans for a career.	5	4	3	2	1
39 During adolescence I was warned not to become sexually intimate at an early age.	5	4	3	2	1
40 During adolescence I experienced a great deal of conflict with my parent(s) or guardian(s).	5	4	3	2	1

Q-9 Based on your own experience, please indicate (by marking the appropriate box) whether each of the following statements best characterizes men or women or whether the statement equally characterizes men and women. Please respond to every statement and mark only one box per statement.

		BEST CHARACTERIZES		
		Men	Women	Men & Women Equally
1	Have the most understanding of the real needs of children	☐	☐	☐
2	Reliable and dependable	☐	☐	☐
3	Shirks family and personal responsibilities	☐	☐	☐
4	Careless in matters related to personal and household cleanliness	☐	☐	☐
5	Most subject to violent outbursts of temper	☐	☐	☐
6	Most conscientious in preparing for an event or outing	☐	☐	☐
7	Show greatest warmth toward those less fortunate than themselves	☐	☐	☐
8	Most faithful in marriage or romantic relationships	☐	☐	☐
9	Least willing to accept responsibility for actions which affect the happiness of others	☐	☐	☐
10	Reported to give the greatest happiness to other people	☐	☐	☐
11	If in charge of finances, least likely to go dangerously in debt	☐	☐	☐
12	Prone to take advantage of any situation to further their own selfish needs	☐	☐	☐
13	Personal conscience fails to inhibit reprehensible behaviour	☐	☐	☐
14	Most prone to punctuality out of consideration for others	☐	☐	☐
15	Remain most loyal to friends and causes under fire	☐	☐	☐
16	Persons in whom trustworthiness has been found to be highest	☐	☐	☐
17	Most likely to be sensitive to the feelings of others	☐	☐	☐
18	Fundamentally more prone to impose one's will on others	☐	☐	☐
19	Most inconsistent in handling children	☐	☐	☐
20	More likely to make pretenses socially rather than reveal their real attitudes	☐	☐	☐
21	Receive the most satisfaction from family life	☐	☐	☐
22	Offer the most encouragement or support to family members	☐	☐	☐

THANK YOU!

Your participation in this study will provide us with valuable information about the relationship between children's development and family experiences.

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