Petición:
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Pedido por:

Centro: Universidad Autónoma de Madrid. EDIFICIO BIBLIOTECA DE CIENCIAS. - $UAMC - pi.ciencias@uam.es

Departamento:

Usuario: - -

Datos bibliográficos:

Publicación: American Journal of Human Biology
Artículo: Physiological maturation, reproductive patterns, and female fecundability in
ISSN/ISBN: 1042-0533
Autores: Varea C, Bernis C, Elizondo S
Lugar de publicación:
Editor:
Año: 1993
Volumen: 5
Número: 3
Páginas: 297-304

Notas: En Museo de Ciencias 6-c-4

Tipo de documento: R
Préstamo: N
Soporte solicitado: E
Medio servido: C
Nivel de demanda: 1

Datos del 1 curso:

Pedido a: !CSICN - CSIC. Museo Nacional de Ciencias Naturales (M-MNCN)
Pedido el: 2017-01-30 11:56:20
Respuesta el: 0000-00-00 00:00:00
Respuesta:
Notas:

Datos del préstamo:

Prestado por: -
Recibido el:
Prestado el:

AMERICAN JOURNAL OF HUMAN BIOLOGY 5:297–304 (1993)

Physiological Maturation, Reproductive Patterns, and Female Fecundability in a Traditional Moroccan Population (Amizmiz, Marrakech)

C. VAREA,[1] C. BERNIS,[1] AND S. ELIZONDO,[2]
[1]*Unidad de Antropologia, Dpto. de Biologia, Universidad Autonoma de Madrid, Madrid, Spain; and* [2]*UPR 221 du CNRS Dynamique Bioculturelle, Aix-en-Provence, France*

ABSTRACT The interaction between age at menarche, adolescent motherhood, and subfecundity were evaluated in 496 Moroccan women 25–54 years of age from the province of Marrakech. Since this population is characterized by later sexual maturation and early marriage, significantly increased subfecundity, measured by the waiting time to first live birth and the incidence of fetal loss, was expected. Menstrual age was defined as the difference between age at marriage and age at menarche. Social access to reproduction was conditioned by age at menarche: early maturers married at a younger age, while late maturers had a significantly shorter menstrual age despite the fact that married at a significantly older age. Although there was a tendency for late maturers to have longer waiting times and more fetal loss, there were no significant differences for either variable according to menarcheal age. Women with a shorter menstrual age became pregnant within the first year after marriage significantly less frequently than women with a greater menstrual age, but did not experience a greater occurrence of fetal loss during their reproductive life. The results indirectly support the hypothesis that the regularity of ovarian function is similar among populations independent of the timing of menarche.

The interaction between age at sexual maturation and reproductive patterns may influence waiting time and fetal loss in the first pregnancy among and within populations. Nevertheless, the demographic impact of such variation is apparently slight.

Initial menstrual cycles after menarche tend to be anovulatory (Apter et al., 1978; Gray, 1979; James 1979; Trussell and Wilson, 1985; Ohadike, 1979; Vollman, 1977). Using basal temperatures, the frequency of ovulatory cycles increases slowly from about 44% in the first year after menarche to about 83% by the fifth year (Vollman, 1977). Data based upon plasma hormonal profiles show similar results (Apter et al., 1978; Apter, 1980; Venturoli et al., 1987). Further, the increase in ovulatory cycles is inversely related to age at menarche. Girls who reach menarche at ≤ 12 years achieve a 50% ovulation rate within one year after menarche, while those reaching menarche at > 13 years do not achieve 50% ovulatory cycles until 4.5 years after menarche (Apter and Vihko, 1983; Vihko and Apter, 1984). Ovulatory cycles in adolescents are often characterized by defects in follicular development and short, or otherwise inadequate, luteal phases (Lenton et al., 1984; Apter et al., 1987). On the other hand, some authors have suggeted that fetal loss increases significantly in early and/or late maturers (Madrigal, 1991; Liestol, 1980; Berkowitz, 1981; Wyshak, 1983).

Most of the preceding results are based upon Western populations. Thus, there is a lack of cross-cultural data to test the relationship between age of sexual maturation and the regulation of the ovarian function in different populations, and to evaluate the degree of concordance for intrapopulational variability. Results from traditional groups

Received May 18, 1992; accepted January 8, 1993

such as the San from Botswana (Van der Walt et al., 1978), the Serere from Senegal (Rosetta, 1990), the Lese from Zaire (Ellison et al., 1989) and the Ganj from Papua New Guinea (Johnson et al., 1987, 1990) suggest differences in the variability of ovarian function among populations. Nevertheless, intrapopulational differences in the timing of regulation of ovarian function relative to age at menarche have not been reported.

Environmental and cultural factors are relevant for understanding differences in physiological maturity, access to maternity, waiting time to first birth, and their relationships. Cultural traditions shape patterns of reproduction, while environmental circumstances related to nutrition and physical work during childhood and adolescence influence biological growth and maturation (Naeye, 1981; Wyshak, 1983; Frisancho et al., 1984; Wood et al., 1985; Riley et al., 1989; Garn et al., 1984; Ellison, 1982; Bongaarts, 1980; Komlos, 1989).

Therefore, an evaluation of interactions among physiological maturity, access to maternity, and waiting time to first live birth is relevant for populations characterized by late age at menarche and early maternity. It is hypothesized that such populations will show a prolonged waiting time at first live birth due to higher subfecundity and a higher rate of fetal loss compared to Western populations. Intrapopulation variability is expected at two levels: (1) women with a shorter time between menarche and marriage will show lower fecundability independently of menarcheal age; and (2) late maturers married soon after menarche will have prolonged waiting times. This paper analyzes the interaction among age at menarche, age at marriage, and waiting time to first birth and fetal loss in the first pregnancy in a Moroccan population characterized by a relatively later sexual maturation (82.5% of women reach menarche at $\geq$14 years, 15.0% at 13 years, and 2.5% at 12 years) (Varea, 1990) and a traditional reproductive pattern which includes a high frequency of adolescent maternity (50% of the women have been mothers before 20 years of age) (Varea, 1990).

MATERIALS AND METHODS

A sample of 496 married women living in 5 of the 10 communes of the area of Amizmiz, province of Marrakech, Morocco, (Fig. 1) were studied. The sample is part of a research project on fertility and infant mortality developed in urban and rural areas of the province of Marrakech from 1982 to 1985. The program was commissioned by the Public Health Agency of the province of Marrakech, and designed and carried out by a research team of the CNRS (UPR 221 CNRS, France) and L'Equipe d'Ecologie Humaine, Faculté de Sciences, Université de Marrakech (Morocco). The surveys collected data from 8,000 women (Crognier, 1987, 1989; Crognier and Zarouf, 1987).

The population lives primarily on traditional agriculture with an absence of mechanization. They live in a lowland Berber-speaking area which includes the small town of Amizmiz. Women play a fundamental role in the familial economy, as is generally the case in rural Morocco (Maher, 1982; Direction de la Statistique, 1984). Harsh socioeconomic and ecological conditions and geographic and cultural isolation characterize the area. Levels of electrification and access to running water are low (28% and 34% of the households, respectively) (Varea, 1990) and illiteracy is high (93% of women and 62% of men) (Varea, 1990).

As with much biodemographic research in countries with limited vital statistics, retrospective data may present errors due to several factors, especially misstatement of age. However, information about the marital life of women was collected by local health nurses, who have a good knowledge of the families living in the area and who ask the woman's age for each event. This is a more accurate method than direct questions on dates (Goldman et al., 1979). Subsequent screening of the data has further reduced errors (Crognier et al., 1992, 1993; Varea, 1993). Biodemographic provincial data (Direction de la Statistique, 1984; Centre d'Etudes et de Recherches Démographiques, 1988) show good agreement with the information available from the questionnaires. The distribution of recorded ages of women shows the expected concentration at ages ending with zero, while other reported ages, such as age at marriage and age at first and last maternity, do not. Since all age groups showed similar patterns of age clustering, analysis of differences between intrapopulational groups was largely unaffected.

Menstrual age was defined as the difference between age at marriage and age at menarche, avoiding the inclusion of the waiting time to first live birth in order to

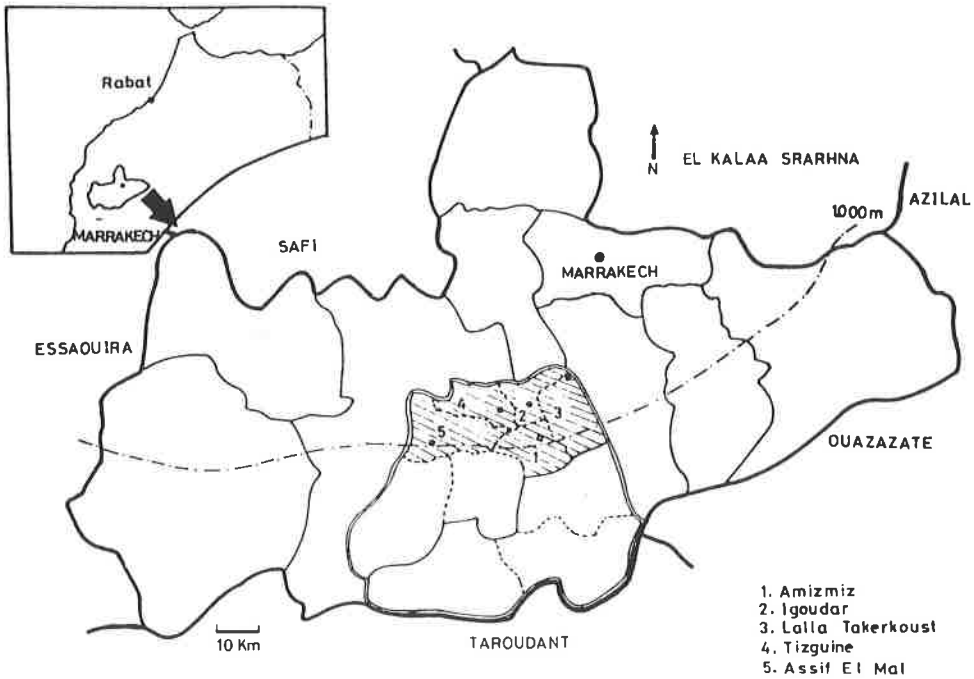

Fig. 1. Location of the communes of the area of Amizmiz, Marrakech, Morocco.

evaluate the influence of both age at menarche and age at marriage on the waiting time to first live birth and fetal loss (spontaneous abortions plus stillbirths) during the first pregnancy. Menstrual age so defined is used to evaluate the stage of ovarian maturation when marriage occurred. The term "gynecological" age, the time elapsed between menarche and first pregnancy or first maternity (Zlatnik and Burmeister, 1977), is widely used in the literature for similar purposes, although it includes the waiting time to first live birth, which is not useful for the present study.

An increase in mean waiting time to first birth with age has been reported in several populations (Goldman et al., 1985). This phenomenon has also been observed in the Azizmiz population and in others in the Marrakech region (Varea, 1990, 1993; Naber, 1989; Crognier et al., 1992, 1993), a fact that could be due to errors of recall or to the inclusion of a group of younger women who have not yet had their first birth. To avoid these factors associated with extreme female ages, a group of 496 from a total sample of 842 women between 25 and 54 years of age was selected. Women who attained menarche within the year of their marriage or after marriage (menstrual age equal 0 or negative) were not included in the analysis (68 women, 13% of the sample).

Three groups were defined on the basis of menstrual age according to Mitchell and Bracken (1990): short, $\leq$2 years; medium, 3–7 years; and long, 8+ years. The sample was also divided into three groups according to the mean age at menarche (14.55 $\pm$ 1.28 years); early, medium, and late maturers, $\leq$13, 14–15, and $\geq$16 years, respectively.

The following statistical packages were used: BMDP Spearman rank correlation (BMDP3S) and analysis of variance and "t" test for unequal variances (BMDP7D) programs, and EPISTAT chi-square. The data were logarithmically transformed in order to normalize the distribution of waiting time.

RESULTS

Biosocial variables for the total sample are given in Table 1. Early marriage, young maternal age at first birth, and short waiting time to first birth are the norm (18.9 and

TABLE 1. Mean values of biosocial variables in women 25–54 years, Amizmiz, Marrakech

	n	$\bar{X}$	SD
Chronological age (yrs.)	496	37.6	8.0
Age at menarche (yrs.)	496	14.5	1.3
Age at marriage (yrs.)	496	18.9	2.9
Waiting time (mos.)	401	19.5	17.4
Age at first birth (yrs.)	469	20.5	3.3
Menstrual age (yrs.)	496	4.4	2.9

20.5 years, and 19.5 months, respectively). Thus, traditional reproductive patterns are still prevalent. Late menarche (14.5 years; 82.3% of women reach menarche ≥14 years, 15.3% at 13 years, and 2.4% at 12 years) and short menstrual age (4.4 years) also characterize the women.

Relationships between pairs of variables are summarized in Table 2. Age at menarche and age at marriage are significantly and positively correlated. Menstrual age, age at menarche, and age at marriage are also significantly related. The correlation between menstrual age and age at menarche is negative. Waiting time to first birth is not significantly correlated with the remaining variables.

Table 3 presents the biosocial variables by menarcheal age groups. Age at marriage increases significantly with age at menarche. Menstrual age is significantly shorter in late maturers although they marry at a significantly older age. There are no significant differences in mean waiting time to first live birth and in the percentage of pregnancies during the first year after marriage. Nevertheless, there is a tendency for waiting time to increase with menarcheal age (Table 4). The mean total number of abortions per woman increases in women with early and late menarche, although the difference among groups is not significant (Table 3). Women with late menarche show a higher percentage of fetal loss in the first pregnancy, but the difference is not significant (Table 5).

Biosocial variables in the three menstrual age groups are shown in Table 6. Women with a short menstrual age have a significantly later age at menarche and a younger age at marriage than the other two groups. Due to differences in age at marriage, the number of pregnancies and live births decreases significantly with an increase in menstrual age from 6.9 pregnancies and 6.2 live births in women in the short menstrual age group to 4.0 and 3.7, respectively, in those of the long menstrual age group.

Mean waiting time to first birth is greater in women with a short menstrual age, although the differences are not significant (Table 6). However, when the number of women in each menstrual age group who became pregnant during the first or subsequent years after marriage is considered, there is a significant increase, from 50.0% in women with the shortest menstrual age to 69.0% in those with the longest (Table 7). Significant differences in the mean total number of abortions and stillbirths are not apparent (Table 6), but there is a tendency for a higher frequency of failed first pregnancies (abortions and stillbirths) in the longest menstrual age group (Table 8).

DISCUSSION

According to Ellison (1991), ovarian function shows a gradual response to constitutional, environmental, and behavioral factors which suggests that the extent of intra- and interpopulational variability in ovarian function should be similar to that found for other biological variables related to development. The available evidence suggests a different growth dynamic between populations from developed countries and those from traditional ecosystems in the developing countries. Among the latter, adolescents grow actively in height and weight into the late teens, which means that menstrual age may not have the same biological implication for early and late maturers (Naeye, 1981; Riley et al., 1989; Frisancho et al., 1984).

With regard to the processes of maturation, reproduction, and subfecundity, there are three fundamental issues. Does the later age at menarche, which is characteristic of the sample of Moroccan women, determine a longer waiting time to first live birth compared to other populations without birth control? Second, is there intrapopulational variability in subfecundity due to differences in age at menarche? Third, does a very short menstrual age determine differences in waiting time and occurrence of fetal loss?

The mean waiting time, 19.5 months, does not differ significantly from that in other populations with similar or lower ages at menarche and absence of contraception (Gray, 1979; Bongaarts and Potter, 1983). Only in populations with very late menarche (18+ years, such as in some groups in New

TABLE 2. Spearman rank correlations of biosocial variables in women 25–54 years, Amizmiz, Marrakech (n = 390)

	Age at menarche	Age at marriage	Waiting time to first birth	Menstrual age	Total mean number of abortions per women
Age at menarche	–				
Age at marriage	.29[1]	–			
Waiting time to first birth	.05	−.06	–		
Menstrual age	−.27[1]	.80[2]	−.07	–	
Total mean number of abortions per women	.08	.02	.05	−.07	–

[1]$P < 0.01$
[2]$P < 0.001$

TABLE 3. Biosocial variables by menarcheal age group in women 25–54 years, Amizmiz, Marrakech

	Menarcheal age groups (yrs.)								
	Mch. g. 1 <13			Mch. g. 2 13–15			Mch. g. 3 ≥16		
	n	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD
Chronological age (yrs.)	88	37.1	8.9	311	37.4	8.8	97	38.8	9.3
Age at marriage (yrs.)[1]	88	17.8	2.8	311	18.0	2.9	97	19.7	2.3
Menstrual age (yrs.)[2]	88	4.9	2.8	311	4.5	3.0	97	3.2	2.2
Waiting time (mos.)[3]	73	16.9	7.8	250	20.4	19.0	78	19.2	18.6
Pregnancies	78	6.5	4.1	264	5.7	3.2	76	6.7	3.8
Live births	88	5.7	3.5	311	5.4	2.9	97	6.0	3.1
Stillbirths	88	0.3	0.7	305	0.2	0.6	96	0.4	0.7
Abortions	75	0.4	1.0	266	0.2	0.5	76	0.3	0.7

[1]Age at marriage: Mch. g. 1/Mch. g. 2: $t = -3.41$, df = 148, $P = .0009$**
Mch. g. 1/Mch. g. 3: $t = -5.12$, df = 168, $P = .0000$***
Mch. g. 2/Mch. g. 3: $t = -2.65$, df = 208, $P = .0087$*
[2]Menstrual age: Mch. g. 1/Mch. g. 3: $t = 4.50$, df = 162, $P = .0000$***
Mch. g. 2/Mch. g. 3: $t = 4.65$, df = 223, $P = .0000$***
[3]Values for waiting time were logarithmically transformed for the analysis of variance.

TABLE 4. Waiting time to first birth in women 25–54 years by menarcheal age group, Amizmiz, Marrakech[1]

Waiting time (mos.)	Menarcheal age groups (yrs.)					
	Mch. g. 1 <13		Mch. g. 2 13–15		Mch. g. 3 ≥16	
	n	%	n	%	n	%
<12	41	56.2	142	56.8	42	53.8
13–24	28	38.3	74	29.6	27	34.7
>24	4	5.5	34	13.6	0	11.5

[1]Chi-square 4.80, df 4, $P = .308$

Guinea) (Johnson et al., 1990; Wood et al., 1985) are there indications of an association between later maturation and longer waiting time to first live birth (Gray, 1982). In Moroccan women, age at menarche and age at marriage are significantly correlated so that the social access to reproduction is, to a large extent, conditioned by the age of sexual maturation. However, the waiting time to first birth is not significantly correlated with age at menarche or with age at marriage. This suggests that there is no difference in fecundability associated with age at menarche or a "catch-up" for timing of first pregnancy according to age at marriage (Varea, 1990, 1993; Crognier et al., 1993).

With regard to the second question, there is evidence that women with very early or late menarche experience more infertility and fetal loss (Liestol, 1980; Wyshak, 1983; Madrigal, 1991). In our sample, early maturers seem to marry and become mothers at a younger age. Although a late menarche appears to delay marriage, later menarche is associated with a shorter interval between maturation and reproduction. Thus,

TABLE 5. Distribution of outcome of first pregnancy in women 25–54 years by menarcheal age group, women 25–54, Amizmiz, Marrakech [1]

First pregnancy	Menarcheal age groups (yrs.)					
	Mch. g. 1 <13		Mch. g. 2 13–15		Mch. g. 3 ≥16	
	n	%	n	%	n	%
Fetal losses	3	3.6	20	6.9	10	10.4
Live births	80	96.4	271	93.1	86	89.6

[1]Chi-square 3.18, df 2, P = .203

TABLE 6. Biosocial variables by menstrual age group in women 25–54 years, Amizmiz, Marrakech

	Menstrual age groups (yrs.)								
	Mst. g. 1 <3			Mst. g. 2 3–7			Mst. g. 3 ≥8		
	n	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD
Chronological age (yrs.)	145	37.6	8.5	296	37.8	9.2	55	36.4	8.4
Age at menarche (yrs.)[1]	145	14.9	1.5	296	14.4	1.2	55	14.2	1.0
Age at marriage (yrs.)[2]	145	16.6	1.5	296	18.9	1.5	55	24.9	3.0
Waiting time (mos.)	116	20.3	19.5	243	19.2	16.4	42	18.9	17.1
Pregnancies[3]	119	6.8	3.5	251	6.0	3.5	48	4.0	3.1
Live births[4]	145	6.2	3.0	296	5.6	3.0	55	3.7	2.6
Stillbirths	143	0.3	0.8	291	0.3	0.6	55	0.2	0.5
Abortions	119	0.3	0.6	253	0.2	0.7	48	0.7	0.8

[1]Age at menarche: mst. g. 1/mst. g. 2: t = 3.54, df = 237, P = .0005***
mst. g. 1/mst. g. 3: t = 4.33, df = 142, P = .0000***
[2]Age at marriage: mst. g. 1/mst. g. 2: t = −15.54, df = 279, P = .0000***
mst. g. 1/mst. g. 3: t = −19.74, df = 64, P = .0000***
g. a. g. 2/g. a. g. 3: t = −14.46, df = 59, P = .0000***
[3]Pregnancies: mst. g. 1/mst. g. 3: t = 5.11, df = 97, P = .0000***
mst. g. 2/mst. g. 3: t = 3.97, df = 70, P = .0000***
[4]Live births: mst. g. 1/mst. g. 3: t = 5.81, df = 112, P = .0000***
mst. g. 2/mst. g. 3: t = 4.82, df = 83, P = .0000***

TABLE 7. Waiting time to first birth in women 25–54 years by menstrual age groups, Amizmiz, Marrakech

Waiting time (mos.)	Menstrual age groups (yrs.)					
	Mst. g. 1[1] <3		Mst. g. 2 3–7		Mst. g. 3[1] ≥8	
	n	%	n	%	n	%
0–12	58	50.0	138	56.8	29	69.0
13–24	46	39.7	77	31.7	6	14.3
>24	12	10.3	28	11.5	7	16.7

[1]Mst. g. 1/Mst. g. 3: Chi-square 9.08, df 2, P = .0106**.

late maturers have a shorter menstrual age than early maturers, although the former marry significantly later. There is a tendency for late maturers to have a longer waiting time and more fetal loss, although the differences are not significant by menarchael age. Two facts must be taken into account in interpreting these results. First, Apter et al. (1978), in data from northern European women, found a difference of 3.5 years in the time at which 50% of ovulatory cycles were attained in girls with menarche age <12 and >13 years. Because 82.3% of women of our sample reached menarche at >14 years, it is possible that intrapopulational differences in the timing of regulation of cycles are not relevant in this population. Data on hormonal profiles are needed to more specifically evaluate ovulatory cycles. Second, differential maternal mortality is suggested. High maternal mortality in Morocco (300/100,000) (United Nations, 1991)

TABLE 8. Outcome of first pregnancy in women 25–54 years by menstrual age groups, Amizmiz, Marrakech[1]

Outcome of first pregnancy	Menstrual age groups (yrs.)					
	Mst. g. 1 <3		Mst. g. 2 3–7		Mst. g. 3 >8	
	n	%	n	%	n	%
Fetal loss	8	5.7	20	7.1	5	10.2
Live births	132	94.3	261	92.9	44	89.8

[1]Chi-square 1.130, df 2, $P = .568$

could particularly influence primiparous adolescent women, especially those of low menstrual age or those with very late menarche. The latter are probably more delayed in development and perhaps pelvic growth, which occurs largely after menarche and the maximum increase in height (Moerman, 1982; Ellison, 1991). One possible explanation for the absence of significant differences in abortion rates and waiting time among groups could be that maternal mortality affects mainly late maturers with short menstrual age, and because of this they could be underrepresented in the surviving population.

Finally, does a very short menstrual age determine intrapopulational differences in waiting time and occurrence of fetal loss? The results indicate a delay in waiting time in women with short menstrual age, but not a greater occurrence of fetal loss during reproductive life. In the results of the World Fertility Survey on age at marriage, mean waiting time to first birth and subsequent fertility are similar (McDonald, 1984). Women with a shorter menstrual age experience longer, although not significantly longer, waiting time to first birth and get pregnant within the first year after marriage significantly less frequently than women with a longer menstrual age. This observation provides indirect support for the hypothesis that regularity of ovarian function is similar among populations independent of the timing of menarche.

ACKNOWLEDGMENTS

The research project on fertility and infant mortality developed in the province of Marrakech was carried out with funds from the Ministre Française de la Recherche et de la Technologie. This study was carried out with the support of the CICYT Research Project PB-88-0175, Ministerio de Educación y Ciencia, Spain.

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