Quantifying the prospects for consanguineous marriage when fertility declines

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Abstract: Even in traditional societies where marriage among relatives is wide-spread, fertility is declining. So is the availability of eligible cousins. The custom of cousin marriage has so far persisted in the face of modernization, but cannot persist – at present levels and in present form – in the face of the demographic transition. We show through simulation that current and projected fertility levels in Middle Eastern countries create challenging constraints on the custom once today's birth cohorts reach marriageable age. Either consanguinity prevalence will diminish significantly, or the institution will be forced to adapt, by becoming much more coercive in the face of reduced choice, or at the expense of other social preferences (such as for an older groom wedding a younger bride). Accordingly, fertility decline affects prospects for social change not only through its well-known consequences for mothers, but also through shaping marriage conditions for the next generation.

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Consanguinity in the contemporary world

Consanguinity – or marriage between close blood relatives, in particular first cousins – is widely practiced and even socially encouraged in a band of countries from Mauritania across the Middle East to India , as well as among immigrant and specific religious groups elsewhere (Darr & Modell 1988, Bittles 2003). Recently collected sample prevalence rates in the different regions of these countries include 23-78% in Iran (Abbasi-Shavazi et al. 2008), 25.0-50.0% in Iraq (COSIT 2005), 14.6-63.0% in Syria (Othman & Saadat 2009) 14.6-39.0% in Turkey (Koc 2008) and 25.4-55.4% in Egypt (Khayat & Saxena 2005). Rates of around 40.0-60.0% have also been reported in Sudan, Saudi Arabia, Jordan, Tunisia and Yemen (Khayat & Saxena 2005). Furthermore, anthropological evidence from Sub-Saharan Africa and South East Asia suggests high prevalence rates which the lack of quantitative data is unable to document (Bittles & Black 2010).

While overall prevalence of consanguinity seems to be declining, in some countries the present-day rates are, in fact, higher than those of the preceding generation. Bittles & Black (2010, p. 1780) observe that this 'possibly reflects greater overall survival to adulthood that in turn increases the numbers of marriageable biological relatives'. Conversely,Weinreb (2008) has suggested that perhaps the most important factor in shaping future trends of cousin marriage is the general decline of fertility. Even such traditional societies where consanguinity is common, have witnessed a marked, and in some cases dramatic, decline in fertility in the recent past. That this development diminishes the pool of cousins is obvious. More difficult to intuit is just how quickly the constraints tighten. We examine this question through a series of simulation exercises.

The future of consanguineous marriage is of particular relevance for the potential for social change in traditional Middle Eastern societies, because it can not only reflect current conditions of female autonomy, and currencies of collectivist versus individualist values, but arguably contributes to their reproduction.

Three discrete sets of mechanisms have been identified to highlight the appeal of consanguineous marriage across the greater Middle East (Weinreb 2008). Firstly, women are better able to assert a superior kinship position: unlike exogamous wives who can be more easily divorced and whose children more explicitly belong to their husband's family (Tillion 1983, Mernissi 1987), endogamous wives have a larger local support network and are better able to take advantage of 'kinship solidarity' (Abu-Lughod 1986, Davis 1983). Secondly, in patrilineal marriages property remains within the lineage – a feature especially important in rural communities (Bittles & Black 2010). Thirdly,, the initial bridal payment is generally lower (Dahl 1997). Finally, endogamous marriages are 'expressive acts (that) make pronouncements about the value of kinship of solidarity' (Holy 1989, p. 114). These cultural factors might relate to trust and familial loyalty, the purity of the bloodline and, at a clan level, the security of the group (Schultz & Lavenda 2000). As Bittles (2003) observes, for poor, impoverished rural areas characterized by low levels of maternal education, early age at marriage and first birth, short birth intervals and longer reproductive spans, the socioeconomic benefits of consanguineous marriage often outweigh the biological disadvantages.

Several trends may promote a change in attitudes towards the benefits of consanguinity. Assuming a degree of decision-making independence of bride and groom, the sexual attraction to outsiders as opposed to kin members is likely to be magnetized as a consequence of the increased sexualization of Arab marital decisions – although this is far from clear (Pastner 1986). Furthermore, this may also be increased by the traits of society associated with modernization which include changing preferences for the global/heterogeneous and greater exposure to strangers and the wider world (Jurdi & Saxena 2003). Increased urbanization has also been suggested as a possible factor in driving future declines, because of improved access to education, a 'multiplier effect' on modernization and the relative decline of the importance of individual transmission of property. Improvements in female education may increase marital exogamy through an increased global view, individual empowerment and (financial) independence, and greater awareness of health risks associated with consanguinity.

'Inbreeding', particularly over numerous generations, has been widely reported to have negative implications for childhood mortality and morbidity (Jurdi & Saxena 2003, Bittles 2001).While it is often difficult to isolate the consanguineous-related genetic impact from other socio-demographic factors, mortality differentials of high statistical significance have been confirmed using meta-analysis (Bittles & Black 2010). Finally, a body of literature in political and social science has called attention to other issues including the so-called 'republic of cousins' where the interests of the extended family or group outweigh the state or other economic enterprises (Tillion 1983).

Fertility and the future of consanguinity

Radical change in the prevalence of cousin marriage may therefore be expected to have wide-reaching implications for the social order in Middle Eastern societies, and it is important to gauge how much change in marriage behavior to expect. We explore the implications of different fertility levels for the availability of marriageable cousins through simulation [1]. Figure 1 shows the average number of cousins of the opposite sex as a function of the average number of children reaching adulthood, if this number has been constant across two generations. The shift from historically high fertility of 6-8 down to replacement level around 2 goes hand in hand with an order-of-magnitude decline in the number of cousins. This decline is approximately, but not exactly, quadratic [2]. For example, from the perspective of a single individual, an average of 6.5 adult children implies approximately 18 paternal cousins of the opposite sex, but at 2 children, this number, at approximately 1.35, removes any last semblance of choice.

Of course, even with complete disregard for the agency of the prospective couple, not every dyad is a suitable match. Apart from 'soft', difficult to quantify, factors such as a pronounced personality mismatch of either the youth or their parents, societies with high levels of consanguinity frequently exhibit a preference specifically for paternal cousin marriage, where a woman is married to one of her father's kin, and generally a preference for the bride to be younger than the groom. Enforcing either of these constraints cuts the overall pool of eligible cousins approximately in half. Limiting the search to parallel paternal cousins, where the fathers of bride and groom are brothers, reduces these options further still. However, with 6.5 children on average, even insisting on age and parallel paternal preferences (i.e. with only a 1-in-4 chance of a random paternal cousin being considered eligible), there is still a 95% chance of there being at least one eligible candidate (Fig. 2). Contrast this with the situation where the average number of children is 2. Now, with 1-in-4 being a match, there is less than a 25% chance of there being even a single suitable cousin. Even releasing either the parallel cousin or

the age constraint does not suffice to raise it above 40%. Conversely, applying even minimal real-life subjective preferences reduces the chance of finding an agreeable match among the paternal cousins to the realm of the improbable. The results displayed in Fig. 2 cannot be straightforwardly derived from the average counts in Fig. 1, because they depend on the distributions as much as the means.

In a way, these figures overestimate the availability of cousins, because they assume the perspective of a single individual. The biggest constraint is that some cousins will be married to someone else. An important complementary approach is therefore to examine the largest possible share of individuals for which a match can be found within a pool of cousins. The conclusions reinforce those based on the individual perspective. With an average of 6.5 children, it would, in principle, be possible to match over 80% of individuals in a single pool of cousins; at an average of 2.5 children, only 30%. This is the absolute maximum a dictatorial matchmaker could achieve, without regard for any factor other than gender. In reality, age constraints, but also sequential and independent decision-making would make it all but impossible to attain this upper bound. While this analysis is limited to a single pool of grandchildren for reasons of computational feasibility [3], the dynamic relationship is clear: possibilities for cousin marriage are decidedly more constrained at moderate fertility levels than at the high levels that have characterized the region's populations in the past.

The above simulations assume a constant average, and uncorrelated realized, fertility level across two generations, in order to be able to plot the indicators as functions of a single parameter to highlight the general relationship. To obtain insights that are closer to being predictive for the Middle East, we run the simulations with parameters derived from the reported *Net Reproduction Rates (NRR*) for Egypt, Iran, the United Arab Emirates (UAE), and Yemen, using values from 1980-5, 2005-10, and 2030-5 to broadly represent the fertility experience of today's grandparents, parents, and today's children when they become parents [4]. Using the first two values for the simulation gives an indication of the constraints around cousin marriage for today's children when they reach marriageable age (the 'child generation'), and using the latter two that of their children (the 'grandchild generation'). The range of fertility trajectories, from slow (Yemen) and steady (Egypt) decline, to rapid collapse (Iran, UAE), gives rise to an order of magnitude difference in how challenging it will be to maintain high levels of paternal cousin marriage for another two generations (Table 1). In Yemen, there remains scope for significant levels of consanguinity even under the UN low fertility scenario, although the numerical constraints tighten considerably over time. In Iran and the UAE, by contrast, they make the practice virtually unachievable for an overwhelming majority.

However, these increasingly tight constraints do not spell an inevitable disappearance of consanguinity. After all, 'although modernization theorists argued that consanguinity would decline with time, it has remained quite resilient' (Singerman 2007, p. 23). Some groups may maintain high fertility even as overall fertility declines. Consanguinity could persist as a fairly common behavioral pattern among a significant minority. Not only would this be possible by fully exploiting the scope for cousin marriage within the demographic constraints, but also through 'adaptive' behavior that slackens these constraints. The norm of specifically paternal parallel consanguinity may weaken, while maintaining a preference for cousins, be they paternal, maternal, or even second-degree, over non-relatives. Furthermore, preferences for the male partner to be older than the female might be relaxed. Nonetheless, even if such behavioral changes would allow the quantitative prevalence of some form of consanguinity to persist, the qualitative dynamics would change. From a theoretical anthropological perspective, parallel paternal, maternal, and cross-cousin marriage are fundamentally distinct

phenomena (indeed, Lévi-Strauss's 'Alliance Theory' (1969) relies on treating the former, but not the latter, kind as cases of 'incestuous' endogamy). Moreover, it is not clear to what extent such weaker consanguinity could in fact fulfill the specific economic and other functions paternal first cousin marriage has served in Middle Eastern societies the past. Another structural change concerns the amount of coercion involved. While familial pressure towards a consanguineous union necessarily amounts to some degree of coercion in terms of excluding partner choices outside the family that might otherwise have considered, it is clear that the amount of coercion is greater the smaller the positive choice between cousins. 'Hard coercion' would be required in many more cases where previously 'soft coercion' might have sufficed. At the same time, an increasingly coercive nature of consanguinity in a context of overall societal liberalization would likely reduce its mainstream acceptability.

This is crucial, because declining *de facto* occurrence alone would not necessarily weaken the social norm. A strong social preference for cousin marriage as an 'ideal' form of union could persist even if only a small fraction of unions conformed to the norm. In fact, due to high levels of infant and child mortality, prior to the 20th century, the number of surviving children in Middle Eastern populations is likely to have been considerably below its recent peak. By implication, to the extent that the consanguinity norm was wide-spread in previous eras (the quantitative evidence on historical consanguinity rates is severely limited (Holy 1989)), it will have been so despite the fact that it could not have been a realized experience for a majority. For the marginalization of consanguinity as a norm, it would therefore be necessarily not only that the actual occurrence becomes less common, but that it becomes increasingly at odds with other social trends.

Conclusion

The time horizon of the purely demographic constraint discussed here is one to two generations. Accordingly, other trends of more rapid change, such as income growth or technological change, may well result in these constraints never coming to bear on the actual prevalence of consanguinity. Nevertheless, it is worth knowing that for reasons of population structure alone, cousin marriage in its present form does not have a future as a mass phenomenon in a world of declining fertility. That this conclusion can be stated unequivocally even for countries such as the UAE or Yemen, where the observed rate of consanguineous marriage has recently even been *increasing* (Tadmouri et al. 2009), demonstrates the power of a demographic analysis of the underlying population structure.

Notes

[1] Sets of siblings are drawn from Poisson distributions with the appropriate means.
[2] The deviation from a square relationship is due to the fact that an average of x children per woman does *not* imply that a random individual has x-1 siblings on average, because the number of children an individual's parents have is, by definition, conditioned on being non-zero. In general, sibship size $E(x - 1 \mid x > 0)$ is different from $E(x - 1)$.

[3] The combinatorial problem of finding a maximal matching in a random graph only admits an algorithmic, not an analytical solution.

[4] Technically, the NRRs are period measures, and the simulation takes assumptions about cohort behavior as an input, creating a potential mismatch. However, since we are more interested in the dynamics than absolute levels, the resulting discrepancy is disregarded here. So is the question of unequal sex ratio at birth. The NRRs, which refer to females only, are multiplied by 2 to approximate the number of adult children of either sex. This has at most a marginal effect on the results.

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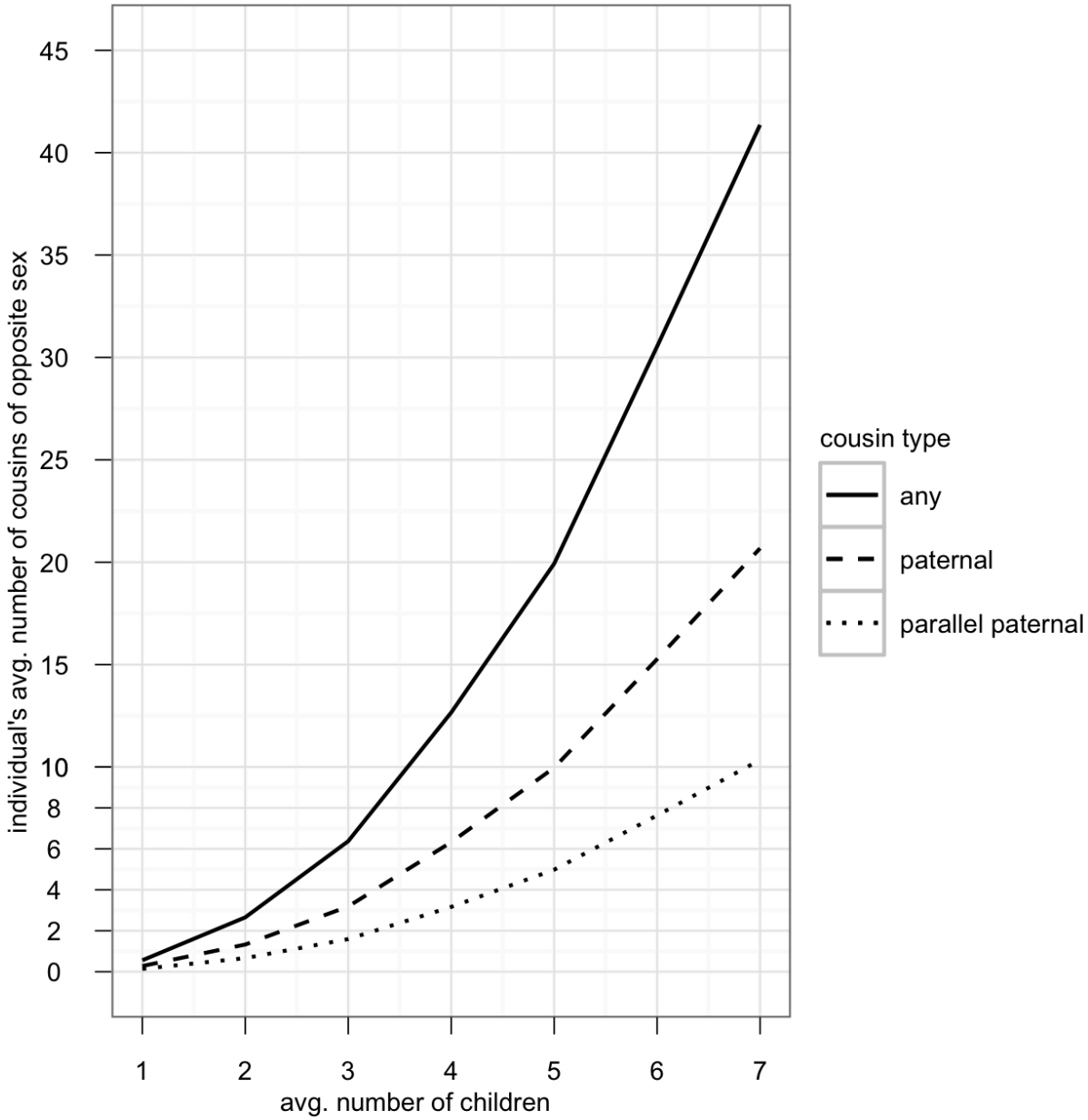

FIG. 1. THE AVERAGE NUMBER OF COUSINS OF THE OPPOSITE-SEX AS A FUNCTION OF THE AVERAGE NUMBER OF CHILDREN. MORTALITY IS IGNORED, SO THIS IS THE NUMBER OF SURVIVING CHILDREN, AND THIS PARAMETER IS ASSUMED TO HAVE REMAINED CONSTANT ACROSS THE PAST TWO GENERATIONS.

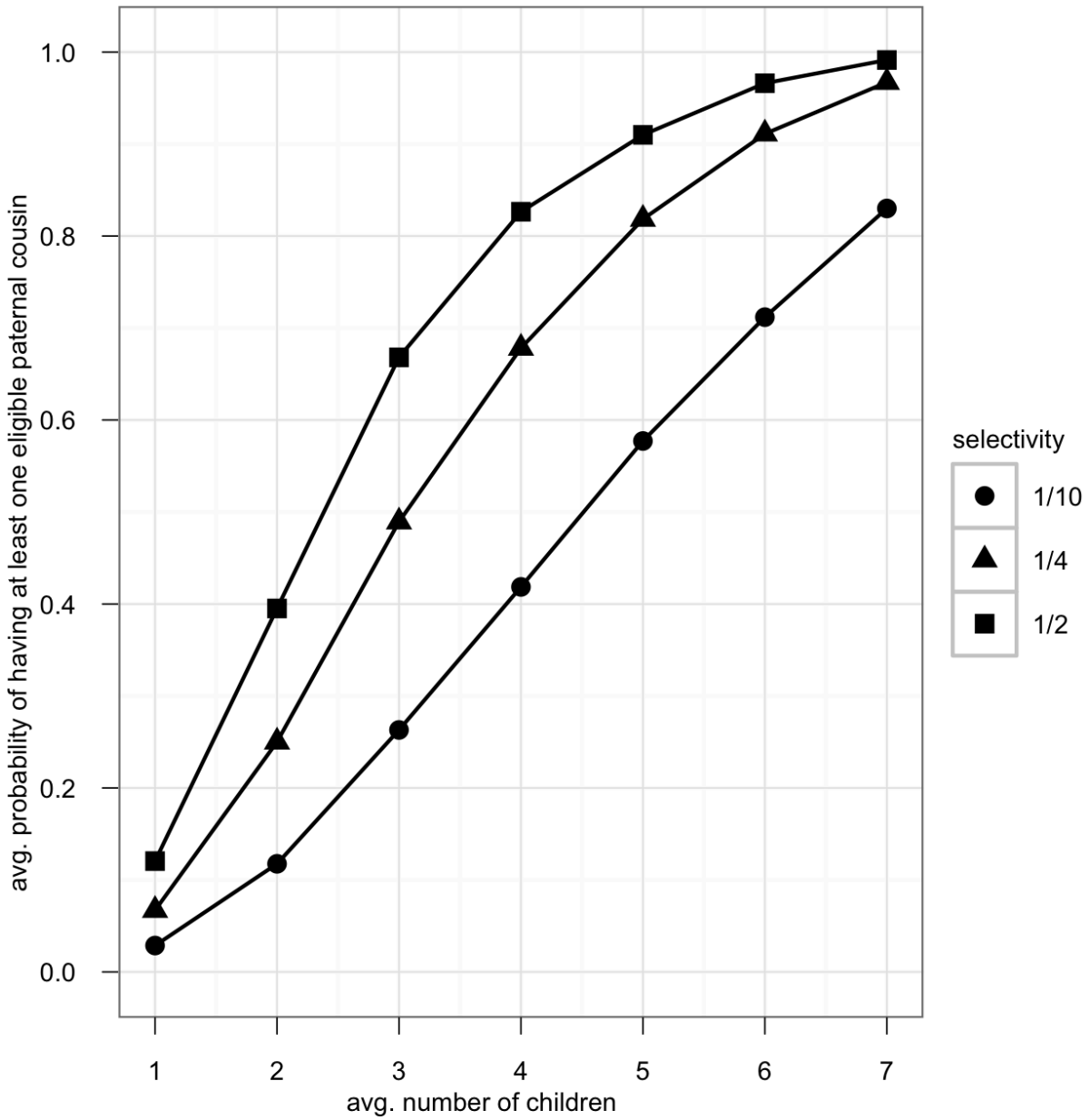

FIG. 2. THE AVERAGE PROBABILITY FOR AN INDIVIDUAL TO HAVE AT LEAST ONE ELIGIBLE PATERNAL COUSIN OF THE OPPOSITE SEX, IF ONLY 1-IN-X IS ASSUMED TO BE ELIGIBLE (DUE TO CONSTRAINTS OR PREFERENCES), AS A FUNCTION OF THE AVERAGE NUMBER OF CHILDREN.

TABLE 1. CONSTRAINTS ON CONSANGUINEOUS MARRIAGE IN SELECTED MIDDLE EASTERN COUNTRIES UNDER DIFFERENT FERTILITY ASSUMPTIONS: AVERAGE NUMBER OF COUSINS OF THE OPPOSITE SEX (BOTH MATERNAL AND PATERNAL, ROUNDED TO 1 SIGNIFICANT DIGIT); PROBABILITY OF A GIVEN FEMALE HAVING AT LEAST ONE OLDER PARALLEL PATERNAL COUSIN (ROUNDED TO FULL PERCENT); AVERAGE MAXIMAL SHARE OF INDIVIDUALS MATCHABLE (IRRESPECTIVE OF AGE ORDER, ROUNDED TO FULL PERCENT) WITHIN A SINGLE POOL OF COUSINS.

					Child generation			Grandchild generation		
	UN scenario	NRR			opposite-sex cousins, (avg. count)	prob. 1+ older, parallel paternal cousin (%)	max. matchable (%)	opposite-sex cousins, (avg. count)	prob. 1+ older, parallel paternal cousin (%)	max. matchable (%)
		1980-85	2005-10	2030-35						
Egypt	med.	2.1	1.34	1	9	58	55	3.7	34	29
	low			0.76	n.a.			2.8	27	28
Iran	med.	2.73	0.82	0.65	7.3	55	58	1.2	15	11
	low			0.42	n.a.			0.9	10	8
UAE	med.	2.44	0.89	0.71	7	54	54	1.7	17	11
	low			0.47	n.a.			1.1	12	7
Yemen	med.	3.35	2.38	1.58	27.5	91	79	12.4	69	64
	low			1.34	n.a.			10.5	65	61