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Blyth, Eric and Lee, Geok Ling

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## **Below population replacement fertility rates: Can assisted reproductive technology (ART) help reverse the trend?**

**Eric Blyth**

### **ABSTRACT**

**Objective:** This paper considers the potential contribution that assisted reproductive technology (ART) may make to population replenishment in countries that have experienced extended periods of below-population-replacement Total Fertility Rates (TFR), by focusing on the specific situation of Singapore, which has recorded ‘ultra-low’ TFRs for many years. **Methods:** The factors contributing to ultra-low TFRs in Singapore, the economic and social consequences of endemic below-population-replacement fertility rates and remedial measures initiated by the government are critically analysed, focussing specifically on the government’s subsidised ART provisions of the ‘Marriage and Parenthood’ package. In addition the paper provides a close analysis of available contemporary data regarding ART and ART outcomes both in Singapore and internationally. **Results:** Despite limited public accessibility to data concerning ART outcomes in Singapore, it is possible to make some assessment of the potential contribution of publicly-funded ART provision and the possible extension of access to elective oocyte preservation to population replenishment. **Conclusions:** Subsidised ART can - at best – make a marginal contribution to government population policy.

**Keywords:** Singapore; below-population replacement fertility rates; assisted reproductive technology; elective oocyte cryopreservation; ‘Marriage and Parenthood’

### **INTRODUCTION**

The government of Singapore frequently asserts that, since the nation has no natural resources, “our people are our assets and our children are most precious as they are our future”<sup>(1)</sup>. To be sure, Singapore’s children are also a rare asset. The total fertility rate (TFR)<sup>1</sup> of Singapore’s resident population fell below the population replacement level of 2.08 in 1975 and - apart from intermittent ‘spikes’, largely attributed to the ‘Dragon Years’<sup>2</sup> of 1976, 1988, 2000 and 2012<sup>(2,3)</sup> – but which have never pushed it back over the population replacement level - has witnessed a persistent decline subsequently to the current ‘ultralow’ levels. Many industrialised countries, particularly in Western and Central Europe and East Asia, are facing similar demographic trends. Weigel’s<sup>(4)</sup> forecast of ‘demographic suicide’ in the European context mirrors a warning to compatriots attributed to Singapore’s current Prime Minister, Lee Hsien Loon: “I don’t think we should ... passively watch ourselves going extinct”<sup>(5)</sup>.

### **MATERIALS AND METHODS**

This paper provides a critical analysis of a range of existing research, data and literature. First, it reviews World Bank data on contemporary fertility trends; these provide the most current information on global TFRs. The paper then discusses localised and specific historical, social, political, religious and cultural factors that impact on fertility rates in particular communities before summarising the

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<sup>1</sup> *Total fertility rate (TFR)* is the average number of live-births each female would have during her reproductive years if she were to experience the age-specific fertility rates prevailing during the period. It is derived by aggregating the age-specific fertility rates of females in each of the reproductive ages for a specific year.

<sup>2</sup> The Dragon is one of the 12-year cycle of animals which appear in the Chinese calendar. In Chinese culture, ‘Dragon Years’ are considered particularly auspicious years in which to give birth.

common characteristics of communities that are affected by below-population-replacement TFRs and analysing the evidence pertaining to the socio-economic consequences of low TFRs. The paper then reviews Singapore government’s population policy. The final sources of evidence on which the paper draws comprise the contribution of assisted reproductive technology (ART) to population replenishment, the development of ART in Singapore and the specific challenges and opportunities offered by elective oocyte cryopreservation (‘social egg freezing’).

## RESULTS

### *Contemporary fertility trends*

Country/territory-specific demographics, drawing on World Bank data, which provide the most up-to-date information concerning international fertility trends confirm recent patterns of largely consistent and persistent declines in TFRs in many developed economies, and below-population replacement TFRs in most Western European and South East Asian Nations. As of 2011, of 193 countries/territories for which data are available, 75 posted below-population replacement TFRs. These are detailed in Table 1.

**TABLE 1: Countries/territories with below population replacement total fertility rates: 2011<sup>(6)</sup>**

Country/territory	TFR	Country/territory	TFR	Country/territory	TFR
Brunei Darussalam	2.0	Vietnam	1.8	Moldova	1.5
France	2.0	Virgin Islands (U.S.)	1.8	Russian Federation	1.5
Iceland	2.0	St. Martin (French part)	1.8	Slovak Republic	1.5
Korea, Dem. Rep.	2.0	Armenia	1.7	Switzerland	1.5
Myanmar	2.0	Aruba	1.7	Ukraine	1.5
St. Lucia	2.0	Liechtenstein	1.7	Austria	1.4
United Kingdom	2.0	Maldives	1.7	Czech Republic	1.4
Uruguay	2.0	United Arab Emirates	1.7	Germany	1.4
Australia	1.9	Barbados	1.6	Greece	1.4
Azerbaijan	1.9	Canada	1.6	Italy	1.4
Bahamas	1.9	China PRC	1.6	Japan	1.4
Norway	1.9	Iran	1.6	Macedonia, FYR	1.4
Sweden	1.9	Montenegro	1.6	Malta	1.4
United States	1.9	Slovenia	1.6	Portugal	1.4
Belgium	1.8	Thailand	1.6	Serbia	1.4
Bermuda	1.8	Trinidad and Tobago	1.6	Spain	1.4
Brazil	1.8	Albania	1.5	Latvia	1.3
Chile	1.8	Belarus	1.5	Poland	1.3
Costa Rica	1.8	Bulgaria	1.5	Romania	1.3
Denmark	1.8	Croatia	1.5	Hong Kong SAR China	1.2
Finland	1.8	Cuba	1.5	Hungary	1.2
Lebanon	1.8	Cyprus	1.5	Korea, Rep	1.2
Lithuania	1.8	Estonia	1.5	Singapore	1.2
Netherlands	1.8	Luxembourg	1.5	Bosnia and Herzegovina	1.1
Puerto Rico	1.8	Mauritius	1.5	Macau SAR, China	1.1

As can be seen, Singapore is located in the lowest echelons of the global ‘fertility league tables’, ranked equal 188<sup>th</sup> (with three other countries, including two East Asian neighbours, Hong Kong SAR

China and the Republic of Korea) of 193 countries/territories<sup>(6)</sup> – a position in which it has been firmly anchored in recent years. 2011 also recorded a slight rise in Singapore’s TFR, compared to the previous year, from 1.15 to 1.20<sup>(7,8)</sup>. 2012, a Dragon Year correlated with previous hikes in Singapore’s birth rate<sup>(2)</sup>, saw a further rise to 1.29<sup>(3)</sup>, although it remains to be seen if the last two years are more than a temporary check on the persistent downward trend of the last four decades. Projected figures for 2013 published in the CIA *World Factbook*<sup>(9)</sup> rank Singapore at the foot of 224 countries/territories for which data are available, with a predicted TFR of 0.79, although it should be noted that this source has previously significantly under-estimated Singapore’s predicted TFR. Table 2 summarises the decline of Singapore’s TFR between 1960 and 2012.

**TABLE 2: Singapore Total Fertility Rate (Per female) 1960-2012**

Year	TFR	Year	TFR	Year	TFR	Year	TFR	Year	TFR
1960	5.76 <sup>(7)</sup>	1985	1.61 <sup>(7)</sup>	1998	1.47 <sup>(10)</sup>	2003	1.25 <sup>(10)</sup>	2008	1.28 <sup>(7)</sup>
1965	4.66 <sup>(7)</sup>	1990	1.83 <sup>(7)</sup>	1999	1.47 <sup>(10)</sup>	2004	1.24 <sup>(10)</sup>	2009	1.22 <sup>(7)</sup>
1970	3.07 <sup>(7)</sup>	1995	1.67 <sup>(10)</sup>	2000	1.60 <sup>(7)</sup>	2005	1.26 <sup>(7)</sup>	2010	1.15 <sup>(7)</sup>
1975	2.07 <sup>(7)</sup>	1996	1.66 <sup>(10)</sup>	2001	1.41 <sup>(10)</sup>	2006	1.28 <sup>(7)</sup>	2011	1.20 <sup>(8)</sup>
1980	1.82 <sup>(7)</sup>	1997	1.61 <sup>(10)</sup>	2002	1.37 <sup>(10)</sup>	2007	1.29 <sup>(7)</sup>	2012	1.29 <sup>(3)</sup>

*Factors that impact fertility rates in particular communities*

Localised and specific historical, social, political, religious and cultural factors exert a key impact on fertility rates in particular communities. For example, cohabitation, and childbearing in cohabiting non-marital relationships are much less frequent in Asian than in Western countries; gender equality in performance of domestic roles is less evident in Asian than in Western families; Confucian ideology in Asian cultures imposes on women with dependent children not only significant child care responsibilities that tend not to be shared equally with their spouse but often obligations for familial elder care as well, and for which they also tend to shoulder the major burden of care; and in Asian cultures, women’s increased educational achievements challenge traditional hypergamous marital traditions<sup>(10-12)</sup>.

Despite these characteristic differences, common patterns may be identified in all developed and economically advanced countries and territories experiencing below-population-replacement TFRs<sup>(10, 12, 13-18)</sup>. To varying extents all have witnessed:

- an increasing proportion of young men and women who choose not to marry;
- a rising age at marriage, thus compacting the window of opportunity for conception due to declining age-related fecundity (especially for women);
- a higher proportion of married couples deciding not to have children at all – or choosing to have fewer children and having them later;
- increasing perception of having children as a personal choice rather than a familial obligation;
- increased levels of marital instability;
- increased non-traditional shared living arrangements;
- higher participation by women in higher education and the labour force;
- increased costs and opportunity-costs of child-rearing;
- work cultures that are insufficiently accommodating of significant domestic responsibilities;
- pressures on women who have both labour market and child-care roles, without concomitant increased sharing of domestic roles by fathers;

- labour market insecurities increasing the risks associated with child-rearing commitments, and
- increasing expectations on parents to maximise the ‘quality’ rather than the ‘quantity’ of their children.

### *Socio-economic consequences of low TFRs*

The major consequences of low fertility rates are an ageing population and consequent increasing cost of old age financial support<sup>(19-22)</sup> and medical and nursing care<sup>(23-26)</sup>. At the same time low fertility rates result in fewer economically productive individuals to carry the burden of old-age support, while a smaller domestic labour force will increase reliance on migrant labour, especially from neighbouring low income countries employed in the “3D” (dangerous, difficult, dirty – and largely low-paid) jobs in construction, manufacturing, marine industries and domestic service<sup>(15,27)</sup>. Evidence of these trends in Singapore is illustrated by the increase in the country’s median age from 19.5 years in 1970 to 38.0 years in 2011; the decline in the ‘old age support ratio’ (the number of those aged 15 – 64 years per elderly person aged 65 years and older) from 17.0 in 1970 to 9.9 in 2011, and the decline in the percentage of the total (resident and non-resident) population formed by Singapore citizens from 90.4% in 1970 to 62.8% in 2011<sup>(28)</sup>.

Looking beyond the statistical manifestations of these demographic trends, then minister for Community Development, Youth and Sports, Dr Vivian Balakrishnan, expressed fears that Singapore could become a society:

“less invested in the future .. [and] more focussed on consumption rather than building up for the future ....[and] ....less buzz, less optimism and verve” – presenting both economic problems and ones that will affect the “tone of society”<sup>(29)</sup>.

### *Government population policy in Singapore*

Since the founding of Singapore as an independent state, following British colonial rule, government population policy has comprised three distinct phases, characterised by the response to the perceived demographic challenges and the nature of the ideological response. The anti-natalist phase (1966-1982) was designed to limit high population growth in the face of inadequate housing and other essential infrastructure. The ‘eugenics’ phase (1983-1987) was designed to improve the quality of the nation’s genetic stock, by containing the fertility of the poor (predominantly Malays) and promoting the fertility of the educated elite (predominantly Chinese). The pro-natalist phase (1987 to the present) was designed to encourage child-rearing among those able to afford it. Given the focus of this paper, further discussion will focus on the current phase, since it was during the more recent stages of this phase that the government added subsidised ART to its menu of pro-family policies. These comprise a four-pronged approach: encouraging marriage; encouraging child-bearing; providing support for childcare, and providing work-life support<sup>(2,10)</sup>.

### *The contribution of assisted reproductive technology (ART) to population replenishment*

Since the birth of the first baby conceived by *in vitro fertilisation* (IVF) in 1978, over 5 million children are estimated to have been born worldwide as a result of mainstream IVF and variant procedures<sup>(30)</sup>. Comprehensive global data regarding ART outcomes are not available because information is not routinely collected in many countries or – as in Singapore – is collected by the

government but not made publicly available. Nevertheless, since 1997 an increasing volume of data from various European countries has been collected, collated and analysed by the European Society for Human Reproduction and Embryology (ESHRE). This shows that – for these countries – ART births comprise up to 4.9% of all births as of 2008 (the most recent year for which the data are available) (Table 3). The highest rates are recorded for the Nordic countries (Denmark, Finland, Iceland and Sweden), Belgium and Slovenia – in all of which ART is available at costs to eligible patients significantly below market rates through publicly-funded healthcare or insurance programmes.

**TABLE 3: ART infants as % of all births – selected European countries: 1997-2008**

Country	1997 <sup>(31)</sup>	1998 <sup>(32)</sup>	1999 <sup>(33)</sup>	2000 <sup>(34)</sup>	2001 <sup>(35)</sup>	2002 <sup>(36)</sup>	2003 <sup>(37)</sup>	2004 <sup>(38)</sup>	2005 <sup>(39)</sup>	2006 <sup>(40)</sup>	2007 <sup>(41)</sup>	2008 <sup>(42)</sup>
Albania	-	-	-	-	-	-	-	-	0.1	-	-	-
Austria	-	-	-	-	-	-	-	0.4	-	1.3	-	-
Belgium	-	-	-	-	1.5	2.1	1.0	2.4	3.5	3.3	4.1	3.9
Croatia	-	-	-	-	-	1.3	1.4	-	1.4	-	-	-
Czech Republic	1.97	-	-	-	-	-	-	-	-	-	-	-
Denmark	2.63	3.04	3.2	3.7	3.9	4.2	3.9	4.2	3.5	4.1	4.9	4.6
Estonia	-	-	-	-	-	-	-	-	-	-	-	4.1
Finland	2.39	2.77	2.7	2.3	2.4	2.9	3.2	2.9	2.7	3.3	3.2	3.1
France	1.21	1.29	1.4	1.4	-	1.5	1.5	1.7	1.7	1.6	1.8	-
Germany	-	-	-	-	-	-	2.6	1.6	1.3	1.6	1.5	1.7
Hungary	-	-	-	-	1.7	1.8	-	-	-	-	-	-
Iceland	3.45	3.79	3.6	3.8	2.8	2.9	2.0	2.0	3.3	3.4	3.7	3.7
Italy	-	-	-	-	-	-	-	-	-	1.0	1.2	1.3
Latvia	-	-	-	-	0.2	-	-	0.2	-	-	-	-
Macedonia	-	-	-	-	-	-	0.5	0.3	0.5	-	-	2.4
Moldova	-	-	-	-	-	-	-	-	-	-	-	0.7
Montenegro	-	-	-	-	-	-	-	-	-	0.8	0.8	1.8
Norway	1.30	1.70	1.8	2.1	2.2	2.4	2.5	2.8	2.8	2.8	-	-
Portugal	-	-	-	-	-	-	-	-	-	-	1.2	1.3
Slovenia	-	-	-	-	3.2	3.5	3.9	3.4	3.9	3.6	4.6	4.4
Sweden	2.25	2.42	2.6	2.5	2.8	2.8	2.9	2.9	2.9	3.3	3.1	3.3
Switzerland	-	0.50*	0.7*	1.0	1.0	1.8	1.5	-	1.5	1.7	-	-
Netherlands	-	-	-	-	-	-	-	-	-	2.4	2.5	2.4
Turkey	-	-	-	-	-	-	-	-	-	-	0.5	0.5
United Kingdom	1.04	1.14	1.6	1.1	1.3	1.4	1.6	1.6	1.6	1.7	1.8	1.9

\*Incomplete data

### *ART in Singapore*

Singapore is a leading pioneer of ART in Asia. For example, the Thomson Medical Centre, set up in 1987, delivered Singapore's first IVF triplets in 1988, delivered one of Asia's first surviving IVF quadruplets in 1999 (although both of these 'achievements' would now be regarded with some circumspection in the light of ART's controversial contribution to multiple pregnancy and multiple birth rates)<sup>(43,44)</sup>; and in 2000 reported the world's first birth resulting from the fertilisation of separately cryopreserved sperm and oocytes<sup>(45,46)</sup>.

Since 17 August 2008, as part of its pro-family ‘Marriage and Parenthood’ package, the Singapore government has subsidised up to three IVF cycles using fresh gametes or embryos, without or without intracytoplasmic sperm injection (ICSI), and gamete intra-fallopian transfer (GIFT), provided by public hospitals<sup>(47)</sup> to married couples who meet the following criteria:

1. Either the husband or wife is a Singapore citizen at the start of the ART cycle;
2. The couple together has no more than one living child;
3. The woman is below 40 years of age at the start of the cycle;  
The woman has been assessed by her doctor to have met the clinical requirements for ART;
4. No more than two embryos must be transferred during the cycle; and
5. The woman has not already received three co-funded cycles.

The amount of co-funding varies according to the citizenship status of the couple (Table 4).

**TABLE 4: Medisave for Assisted Conception Procedures<sup>(47)</sup>**

		Patient’s citizenship status		
		Singapore Citizen	Permanent Resident	Foreigner
Spouse’s citizenship status	Singapore Citizen	50%, up to \$3,000 <sup>#</sup>	35%, up to \$2,100 <sup>#</sup>	25%, up to \$1,500 <sup>#</sup>
	Permanent Resident	35%, up to \$2,100 <sup>#</sup>	Not Applicable	
	Foreigner	25%, up to \$1,500 <sup>#</sup>		

Additionally, couples may also draw on their Medisave account to fund their contribution towards their treatment or to pay for treatment cycles that are not co-funded: up to \$6,000 for the first cycle, \$5,000 for the second cycle and \$4,000 for the third cycle. The three cycle limit is imposed on the grounds that success after three failed cycles is unlikely to occur and that further depletion of a couple’s Medisave reserves could leave them with insufficient savings to meet future hospitalisation expenses, especially following retirement from remunerative employment<sup>(47)</sup>.

Collection of ART-related data in Singapore was initiated by the Ministry of Health in 2007<sup>(48)</sup>. However, since the author’s request for information relating to ART births in Singapore was declined, the following discussion necessarily relies on partial secondary data reported in local media<sup>(48-51)</sup>. In 2006, before the availability of subsidised IVF in Singapore, about 400 of the total 36,272 births in Singapore –about 1.3% - are reported to have resulted from ART<sup>(49)</sup>.

As noted above, the Singapore government does not make ART outcome data publicly available, so ‘best guess’ figures have to be extrapolated from data that are accessible. Tan<sup>(48)</sup> reported the birth of 1,158 ART babies in Singapore in 2009. For the same year, the Singapore government reported 36,925 births in the resident population<sup>(52)</sup>. This suggests that ART accounts for around 3% of all

births. Tan<sup>(48)</sup> reports that up to December 2010, the government subsidy of ART had cost \$9.4 million and had resulted in the birth of an additional 619 babies.

Table 5 below provides details of the number of babies born following ART in Singapore in the period 2007-2009.

**TABLE 5: Babies born following ART in Singapore 2007-2009<sup>(48)</sup>**

Babies born from	2007		2008		2009	
	No	%	No	%	No	%
Singleton birth	475	59.2	520	56.1	678	58.5
Twin births	282	35.2	362	39.1	444	38.3
Triplet births	45	5.6	45	4.9	36	3.1
<b>Total</b>	<b>802</b>	<b>100</b>	<b>927</b>	<b>100</b>	<b>1158</b>	<b>100</b>

### *Elective oocyte cryopreservation*

Oocyte cryopreservation is routinely offered to women whose fertility is likely to be comprised because of necessary surgery, radio- or chemo-therapy and who are unable to cryopreserve embryos – most usually because they do not have a male partner - on the basis of no realistic alternative being available to them<sup>(53,54)</sup>.

However, the availability of elective oocyte cryopreservation (‘social egg freezing’) for young women wishing to preserve their fertility against ageing is more controversial. Advocates for the more ready availability of this procedure argue that it promotes the autonomy of women who have taken advantage of increased opportunities to participate in tertiary education and the labour market, and are trying to balance the demands of motherhood, the consequent pressures of performing multiple roles, the increasing opportunity-costs of childrearing, while an intransigent female ‘biological clock’ dictates the onset of a rapid decline in fertility from the mid thirties<sup>(55-57)</sup>.

Making available elective oocyte cryopreservation in Singapore has been advocated both as a reproductive option for women themselves<sup>(51,58)</sup> and as a means of reversing Singapore’s fertility decline<sup>(51)</sup>.

## **DISCUSSION**

It is generally acknowledged by informed analysts<sup>(10,12)</sup> and even by politicians responsible for their implementation<sup>(5,59)</sup> that, to date, the policies advocated and implemented by the government of Singapore have failed to stem the persistent fertility decline that has now been in effect for almost four decades. Intuitively, since fewer people in their peak child-bearing years are contemplating parenthood either at all, and those who do so are planning to have considerably fewer children than their forebears, expeditious state assistance for those whose family-building aspirations are blocked because of infertility would seem a well-founded policy measure in countries facing severe ultralow TFR challenges. However, the potential contribution of ART to population replenishment – even when it may be affordable, widely available and – other things being equal - more likely to be successful because of its accessibility to younger women – is far from self-evident.



RAND Europe<sup>(60,61)</sup> first undertook an analysis of the potential impact of wider and earlier access to IVF on birth rates, drawing on data from Denmark and the UK. Using the UK as an indicator the authors of this study claimed that the UK's TFR could be increased by 2.5% if IVF was provided for all couples trying to conceive who had failed to do so after three years, and by 15% if IVF was provided after twelve months of failure to conceive. The authors concluded that the contribution of ART to TFRs compared favourably to other pro-family policy measures<sup>(62)</sup>. However, in a penetrating critique of RAND's methodology, Habbema et al.<sup>(63)</sup> noted that the RAND study had inflated the IVF effect by failing to take account of conceptions that would have occurred naturally beyond the 12-month cut-off and concluded that the more modest contribution of early application of IVF towards TFRs could be achieved only at the cost of funding twice the number of IVF cycles and increasing the twin and triplet rate. Habbema et al. concluded that:

“Making IVF available early with the intention to boost national birth rates would be a largely ineffective policy measure with serious costs and side-effects.” (p. 1418).

While Habbema et al. were primarily concerned with the additional financial costs and the adverse effects of an increased number of higher multiple births, social science studies of the impact of Israel's 'pro-IVF' regime provide different insights into the psycho-social costs of easily accessible and affordable ART. Regardless of religion or marital status, any female Israeli citizen may receive an unlimited number of state-funded IVF cycles until the live births of two children. In addition, the state promotes the commercial procurement of oocytes from both indigenous and foreign providers and was the first country in the world to establish a government-appointed body actively to both regulate and facilitate surrogacy agreements.

In 2009 (the most recent year for which data are available) ART births comprised 4.2% of all births in Israel<sup>(64)</sup>. As comparison with European data in Table 3 illustrates, Israel is among the world's leading nations for ART births. While the generous publicly funded Israeli ART programme is often portrayed as a 'win-win' exemplar serving both the family-building aspirations of individuals and the demographic ambitions of the state that may be usefully emulated by other nations, a closer examination of the experiences of women undergoing ART exposes the adverse consequences for women who fail to conceive after undergoing ART (the majority). The state subsidy creates a 'perseverance trap' for women whose attempts at conception are unsuccessful, but who nevertheless feel compelled to keep undergoing treatments since it is not affordability, but their motivation, that brings about the cessation of treatment. These women reported a variety of adverse physical, psychological, relational and physical consequences, such as becoming overweight as a result of repeated hormone injections, high levels of stress, interrupted careers, loss of sexual intimacy with partners, relationship breakdowns<sup>(65-67)</sup>.

The inaccessibility of ART outcome data in Singapore preclude any sort of analysis modelled along the lines of the RAND Europe study – as modified by Habbema et al., and no social scientific research has been conducted among ART recipients in Singapore comparable to the Israeli studies, and in any event the availability of Singapore's subsidised ART programme has been of too recent origin to yet gauge anything other than short-term impacts.

Nevertheless, available ART outcome data for Singapore compare favourably with European and other countries such as Israel that have extensive publicly funded ART programmes, suggesting that any further increase in the contribution of ART to total births in Singapore is likely to be marginal. Further, any such increase might be achieved by higher costs, increased psycho-social pressures on

women for whom ART will not result in conception and higher levels of multiple births, although the latter effect would be mitigated by the comparatively recent imposition of limiting to two the maximum number of embryos that can be transferred in any single treatment cycle.

Similarly, despite enthusiasm expressed in some quarters in Singapore for increased accessibility of oocyte cryopreservation for social reasons<sup>(51,58)</sup>, it would require an unlikely high level of recourse to elective oocyte cryopreservation to exert any noticeable impact on TFRs. In any event, neither the efficacy<sup>(54,68-69)</sup> nor the long-term well-being of children born as a result of the procedure<sup>(70,71)</sup> have yet been satisfactorily established.

Necessary caution dictates that if elective oocyte cryopreservation were to be made available at all – this should be on the basis of a clinical trial to which all the conventional requirements should apply. The technical competence available at Singapore’s fertility clinics could make this a reasonable and realistic option for consideration.

In a recent newspaper commentary, former Prime Minister and Minister Mentor, Lee Kuan<sup>(72)</sup> enumerated the various measures initiated by the Singapore government to ‘encourage marriage and parenthood’. What he failed to highlight was the singular lack of success of these policies to effect any significant impact on the country’s declining fertility. To be sure, effective population policies in the face of ultra low fertility rates have proved elusive for all governments facing a similar demographic predicament. As much was recognised by current Prime Minister, Lee Hsien Loong, who acknowledged there were “no ready answers, no permanent, perfect solutions”<sup>(59)</sup>.

Certainly, there are no ‘quick fixes’, least of all encouraging a massive influx of young migrants<sup>(73)</sup>. Nevertheless, the key sources of disincentives and barriers to family-building in Singapore are well known. Jones<sup>(12)</sup> reports on the outcome of dialogue initiated by the government in 2008 with interested parties that identified the three main concerns as: affordable childcare, a work-life balance that better reflected ‘life’ needs, and increased financial support for families. The government noted the pro-family policies established in Scandinavian countries, but balked at the economic implications of implementing comparable policies in Singapore. In 2003 Wong and Yeoh<sup>(2)</sup> noted that while below replacement fertility was perceived as a ‘national crisis’, it was not considered a sufficient crisis to challenge prescribed ‘Asian’ values that might be contributing towards it. It is also likely that many young people growing up in Singapore are largely ignorant of the likelihood that a significant proportion of them will face fertility difficulties in any event – and that these will be compounded by delayed attempts at family-building. The concerns of government – in Singapore and elsewhere – to warn young people about the pitfalls of ‘too early’ child bearing might well miss the point that they also need to know about ‘too late’ attempts at family-building.

If the government is serious about tackling below replacement fertility rather than merely passing on a worsening demographic problem as an unwelcome legacy to ever-decreasing future generations, economic and cultural ‘givens’ will have to give some ground in the not-too-distant future. Any effective resolution will demand more radical approaches than have hitherto been considered politically acceptable.

ART is likely to play a relatively minor role in any remedial action. However this does not necessarily mean that its potential contribution is insignificant. The government’s comparatively tight control of information renders impossible any independent evaluation of the impact of the subsidised ART programme and hence realistic proposals for change of development. However, review is a necessary

initial step. In addition, Singapore seems well placed to facilitate comparative and observational trials of elective oocyte cryopreservation.

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