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AYeconomics Research Centre, Republican Center for Health
Development, Higher School of Economics, M.Narikbayev KAZGUU
University, Nur-Sultan, Kazakhstan

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Determinants of child mortality risk in Kazakhstan¹

Yolanda Pena-Boquete¹, Aizhan Samambayeva^{*1}, Aigerim Zhumakanova², Galym Makhmejanov³

¹ AYeconomics Research Centre, University of Santiago de Compostela

² Republican Center for Health Development

³ Higher School of Economics, M.Narikbayev KAZGUU University, Nur-Sultan, Kazakhstan

**Corresponding author: a.samambayeva@ayeconomics.com*

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Abstract

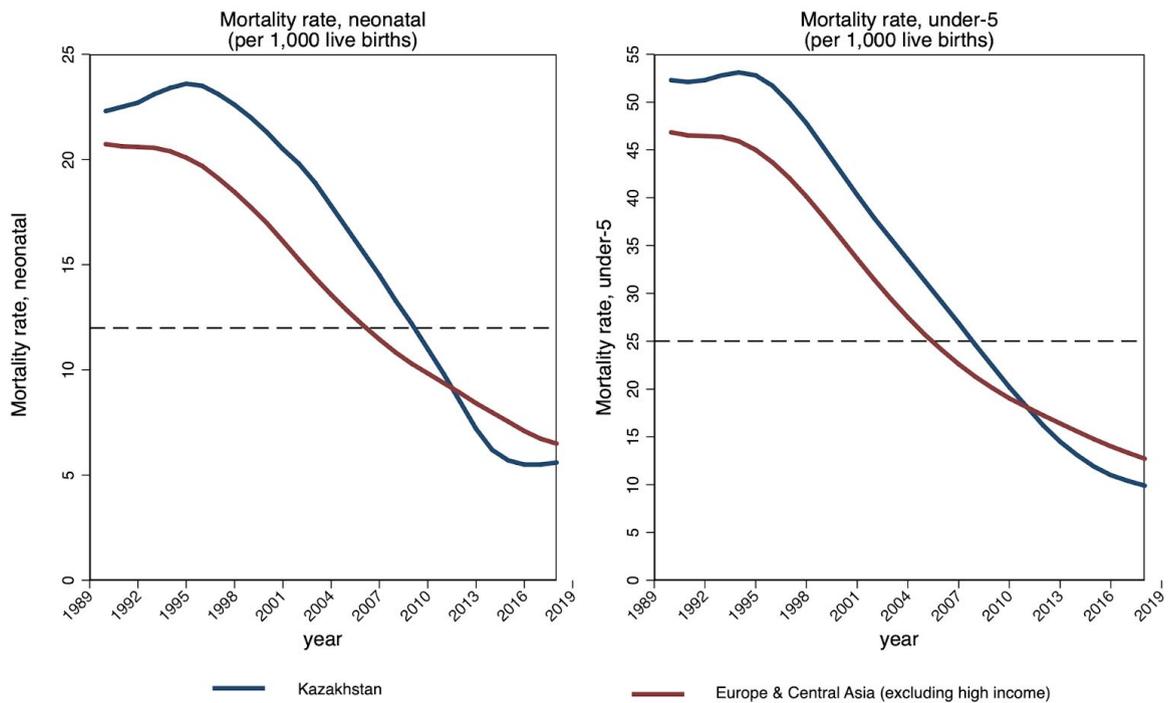
Child mortality rate is one of the key indicators of the Sustainable Development Goals from the United Nations. In the last two decades, this indicator became 6 times smaller during 1990 to 2017 (from 54.1 deaths/1,000 live births to 8.9) in Kazakhstan. This decrease in child mortality rate have been much faster in Kazakhstan than in other countries of Central Asia, so it would be useful to understand the reasons why. Thus, the aim of the paper is to analyze the socio-economic determinants of child mortality in Kazakhstan in order to shed light on the factors behind its huge reduction. In order to estimate the determinants of child mortality we run a logit model based on Multiple Indicator Cluster Surveys (MICS) database provided by UNICEF for Kazakhstan in 2006, 2010-2011, 2015. Results show that household composition may be a relevant variable for explaining child mortality: head of household is a relevant variable; however maternal education doesn't come out significant. Additionally, the access to health resources also reduce infant mortality. On the one hand, the probability that women had experienced the death of a children increases for the 2th and 3th quintile of wealth, i.e. for those who have a worse access to the health resources. On the other hand, the probability that the child dies are higher for families living the rural areas compared with urban areas (explained for the difficulties of reaching the health facilities in rural areas). Results of this paper can be used to keep the positive path in the infant mortality decrease for Kazakhstan and taken as an example for other countries in Central Asia where infant mortality is still high.

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Introduction

To reduce infant mortality rate is a key point to reach the goal 3 “Ensure healthy lives and promote well-being for all at all ages” set by the United Nations (UN) on the 2030 Agenda for Sustainable Development. Kazakhstan departed from quite high values of infant mortality in 1989, 52.3 deaths/1,000 live births for children under 5 and 22.3 deaths/1,000 live births for neonatal kids, and these values even increased after the collapse of Soviet Union and the subsequent economic crises. However, the infant mortality rate have continuously decreased after 1995 reaching the SDG measured through neonatal mortality (set in 12 deaths/1,000 live births) and under 5 infant mortality (set in 25 deaths/1,000 live births) in 2008/2009.

Figure 1: Evolution of the infant mortality in Kazakhstan



As we can see in Figure 1, this decrease had been much faster in Kazakhstan than in other post-Soviet countries from Eastern Europe and Central Asia. Actually, Kazakhstan shows the lowest infant mortality rate from Central Asia countries in 2018. For this reason, it is

important to analyse the factors behind this outstanding decrease in order to help to design better policies from the neighbouring countries.

Post-soviet countries share common characteristics inherited from Soviet Union period such as low weight of primary health care that may have effects on the infant mortality. Other factors such as the effect of households' socio-economic status differences on child health has gained close attention from policy makers and researchers in public health since the last decades. Other factors such as maternal characteristics and environmental contamination have also been found important. Ministry of Health (MoH) of Kazakhstan have developed several governmental programs (2005-2010 program and "Salamatty Kazakhstan" for 2011-2015) to reduce the infant mortality. These programs were strengthening the health of mother and child. This paper shows that the household composition can play an important role in countries where traditionally the parents of the fathers are important in household decisions that may affect their grandkids.

This paper aims to analyse the socio-economics determinants of infant mortality risk in Kazakhstan in order to shed light on the factors behind its huge reduction. The results can be used to keep the positive path and reducing the risk of infant mortality decrease in Kazakhstan and in other post-soviet countries in the area. This paper is organized as follows: we review the literature in the first section in order to describe the estimation model and the database in the second section of the paper. In the section third we present and analyse the results and, finally, we draw some conclusions.

1. Literature review

It's estimated that approximately 97 percent of new-borns are expected to survive during the first five years of life in an optimal setting (Mostley and Chen, 1984). However, the mortality rate and consequently, this survival rate is affected by social, economic, biological, and environmental factors. Mosley and Chen (1984) are the first authors putting together the different factors (biological, medical, economic..) that may affect child mortality. They group the determinants into five groups: (1) Maternal factors, (2) Environmental contamination, (3) Nutrient deficiency, (4) Injury, (5) Personal illness control, and consider that socioeconomic

factors affect the variables of these five groups, and consequently the infant health and mortality rate.

Literature have mainly focuses on factors related to maternal characteristics and contamination, as well as the socioeconomic conditions. Among the maternal factors mother's age, birth interval, birth rank and sibship size (the ultimate number of birth) are usually considered to explain infant mortality rate. Maternal age and infant mortality rate have a curvilinear relation, increasing the risk with younger (Friede et al.,1987) and older ages (Fiede at al., 1988). Birth interval is negatively correlated with infant and child mortality (Wolfers and Scrimshaw, 1975). Mortality decreases from rank one to two and then increase with the next birth showing J-curve correlation. Sibship size has a positive correlation with mortality rate through the competition of resources and maternal care even when birth rank is controlled (Bakketeig and Homan, 1979).

From the environmental factors, water is one of the most important. Poor water supply and sanitation problems lead to one of the leading causes of death among children diarrhoea. The World Health Organization (WHO) estimates that 525,000 children under five die from diarrhoea annually. Most of the time those children were experiencing malnutrition which increases their risk of getting sick. In fact, according to estimations of WHO, child mortality could be reduced by 65 % if water supply, sanitation and hygiene would be managed appropriately. In this line, Susser (1994) revealed that increase of interventions in water supply and sanitation decreased under-five mortality and infant mortality significantly.

Air pollution and mortality have strong correlation and established evidence from academic literature (Loomis et al., 1999). The most robust correlation of mortality rate is found with PM10 level. Air pollution in Sao Paulo (Brasil) is strongly associated with a mortality rate due to respiratory diseases of children under 5 years old (Saldiva et al., 1994). A similar study conducted in Czech Republic (Bobak and Leon, 1992) showed that the risk of respiratory mortality increases with air pollution considering different air pollutant (TSP-10, SO₂, NO_x).

It's also well established the importance of socioeconomic factor on infant mortality such as maternal and paternal education or household wealth. There is a lot of controversial literature on the relationship between maternal education and child mortality as well as the way the

both indicators can be measured. According to Caldwell, J. C. (1993), the maternal education improves child health in two ways. First, maternal education can be used as a proxy of socio-economic status which enhance the use of modern health service. Secondly, mothers with education are likely to have favourable behaviour related to child health. However, maternal education has to be taken with caution. Maternal education may have a positive impact on child health in case if education received is adequate (modern vs religious education), if it is valued by the labour market and improve socio-economic situation or/and there is affordable good quality health service. For example, some studies argue that maternal education is more important in rural areas than in urban ones since behaviour habits of mother can save a child's life. In Cuba, the study demonstrated that there is no big difference in child mortality among the educated and uneducated mothers due to big efforts of country to provide affordable and high quality health service to everyone (Ware, 1984). Flegg (1982) argues the maternal education is significant for child mortality in the countries where income inequality is high. Mother's education is also important in terms of decreasing fatalism related to child's health, better awareness of facilities available, and greater power in managing resources (Ware, 1984).

Some studies have into account both paternal and maternal education. Infant mortality significantly decreased when, infants mother has an 8th grade education and less and father had 12th grade education (MacMahon, et al. 1972). Arntzen et al. (1993) investigated the effect of maternal and paternal education on infant mortality rate. They revealed that father's education level that is at least 12 years is associated with lower stillbirth rate, in comparison with mother's education. The explanation of this distinctive association was impact of husband on the woman's behaviour. Cochrane et al. (1982) argue that most of the literature estimate the greater effect of maternal education on child mortality rate rather than paternal education and father's education is more associated with household income and wealth. However, the study of Breierova and Duflo (2004) demonstrated that mother's education is significant in determining age at marriage and number of children born and doesn't have stronger causal effect on child mortality than father's education.

Wealth is other of the important factor determining infant mortality and actually, WHO stated that poverty is a predictor of mortality and child health (World Health Organization, 1999).

Children from poor families are less likely to survive due to the worse wealth circumstances such as inadequate sanitation, poor house conditions, malnutrition, low birthweight and infections. The study from several African countries showed that child mortality increased in poor families although it reduced for richer families (Stifel et al., 1999). Boyle et al., (2006) investigated the influence of wealth status on child health across 42 developing countries. Wealth variable was measured by an index that contains durable goods and living conditions.² Analysis of data showed significant relationship between wealth and child health, however this relationship should be taken cautiously as definition of wealth varies across countries. Associated with the lower level of household income, single families tend to have a higher risk of mortality compared with two-parent family (Remes et al., 2011).

Taking into account the cultural dimension influencing on the children gender preference or women bargaining power may be important to better understand the child mortality. Gender preferences still prevail in some countries such as China or India, affecting parental behaviour in terms of nutrition, breastfeeding, treatment and immunisation of children (Fuse, 2010). In fact, to be born a girl in India increases the risk to die by 30-50% between the first and fifth years old (Claeson et al., 2000). The reason may be that girls under five are taken to the hospital at already advanced state of illness and less money spent to their treatment (Chatterjee, 1990). Maitra (2004) demonstrated that bargaining power of women in Indian households, measured by if the husband hits the women or if women need permission to visit friends or family, are both statistically significant for prenatal care and hospital delivery which decrease child mortality.

Political economy, health system and institutions have direct influence on access to healthcare and income status of population which may minimize or maximize the effect of other socioeconomic variables such as wealth. Chung and Muntaner (2006) shows that medical coverage is an important predictor of infant mortality in OECD countries. Health system determinants that are improving child survival include number of health workers and beds per capita, out/inpatient medical costs, spending on health per capita, average salary of health workers an etc (Feng et al., 2012). Additionally, the study of Muldoon et al. (2011)

² Household possessions such as owning a car vs motorcycle, having television vs radio, housing characteristics and other consumer durables can be used as approximation of household wealth (Morris et al., 2000). Some studies used the availability of piped water and use of electricity as a proxy for household wealth (Filmer et al., 2001).

discovered a strong association of government corruption and an increase of infant, child and maternal mortality rates.

2. Methodology and database

In order to identify the determinants of the infant mortality we evaluate the risk that a woman had lost a child after he/she was born alive using a logit model. Thus, the dependent variable y takes the value 1 if a woman has lost a child after being born alive with the probability p and takes the value 0 otherwise with the probability $1 - p$. To estimate the probability p , we assume the logistic functional form:

$$p_i \equiv Pr(y_i = 1 | x) = \frac{e^{x\beta}}{1+e^{x\beta}}$$

Being β the parameter vector and x_i the vector of independent variable including mother age and age of the mother to the first child, number of children, household size, maternal and household education, wealth index, region, rural and urban, and ethnicity.

The database used is The Multiple Indicator Cluster Survey (MICS) collected by the United Nations Children's Fund (UNICEF) in collaboration with the Agency of Statistics of the Republic of Kazakhstan. As for Kazakhstan, the survey is available for the years 2006, 2010-2011 and 2015.

Table 1 shows the descriptive statistics of our sample. The number of observations of the pool sample is 28,259 where the main respondents are women aged 15-49 years old. As it is shown in Table 1, 9% of women who gave birth an alive child has lost she/he before their 5 years old (infant mortality rate). The mother's age at the moment of the questionnaire is 36 years old on average, varying from 16 to 49 years old while the age when her first child is born is 22,21, being 12 years old is the youngest age for having the first child. Over 80% of women are married, and the number of members in households are 4,62 persons, having on average more than 2 children.

Table 1: Summary statistics

	Mean	SD	Min	Max
Infant mortality	0.09	0.28	0	1

Age of the mother	36.01	8.04	16	49
Age of the mother at the first child	22.21	3.70	12	48
Married	0.81	0.39	0	1
Number of children	2.36	1.30	0	14
Number of household members	4.61	1.95	1	19
<i>Head of the household level of education</i>				
Primary & Secondary	0.10	0.30	0	1
Upper Secondary	0.36	0.48	0	1
Technical and Professional	0.31	0.46	0	1
Higher	0.23	0.42	0	1
<i>Mother level of education</i>				
Primary & Secondary	0.03	0.16	0	1
Upper Secondary	0.35	0.48	0	1
Technical and Professional	0.33	0.47	0	1
Higher	0.30	0.46	0	1
<i>Ethnicity</i>				
Kazakh	0.61	0.49	0	1
Russian	0.24	0.43	0	1
Other ethnicity	0.15	0.36	0	1
Urban	0.56	0.50	0	1
Rural	0.44	0.50	0	1
Number of observations				28,259

In terms of education, it could be highlighted that there is a larger number of women with higher levels of education compared with the household head. More precisely, there are 33% of women with technical and professional level vs 31% in the case of head of the household.

The difference increases at a higher level, with 30% vs 23%. Regarding the ethnicity and location, approximately two thirds of observations are Kazakh and 56% live in urban areas.

3. Results

Table 3 show the marginals of the logit estimation. We have estimated the model for the pool data and by year in order to capture differences in explicative factors in the last 10 years.

Our results are consistent with the curvilinear relation between infant mortality and mother age that find authors such as Fiede at al. (1988) increasing the risk with younger and older ages. We capture this effect using the mother's age and the age of the mother to the first child. Mother's age has a significant impact on infant mortality, decreasing in 3 by a thousand the risk of losing the kid as the mother gets one year older. However, for the first birth the age of mother has an opposite effect, increasing the risk of losing the kid as she is older.

Size of the household and household composition appears to be significant. As the number of children increases, infant mortality increases in 7.6% the probability of losing a kid. This is consistent with the literature and the competition of resources and maternal care when the number of siblings is high. On the contrary, the increases of the household size by one member decreases the risk of infant mortality in 3.4%. This effect is related with an income effect, due to a higher number of adults in the household.

Considering other studies results, the maternal level of education is expected to have a significant effect on infant mortality. However, just household head level of education appears to have significant effects instead of maternal education. Head of the household with a higher level of education head decreases the probability of having a dead kid by 4.2% compared with primary education. The results show that the effect of mothers' education goes in the same direction, but it is not significant. This result could be attributed to the fact that mothers are not managing household resources but the head of the household. Lower levels of wealth calculated based on the household resources also increases the risk of infant mortality. However, to live in rural areas increases the risk of infant mortality.

A striking fact shown on the table results is that the ethnic may affect the rate, increasing the infant mortality in 2.3% from Russia ethnicity relative to Kazakh, and 2.1% if she is from another ethnic group. Marital status doesn't appear to be significant.

Table 2: Estimation results (Marginals)

	ALL	2006	2010	2015
Age of woman	-0.003***	-0.004***	-0.004***	-0.001
age_first_birth	0.003***	0.005***	0.004***	0.000
married	0.004	0.025***	-0.010	-0.004
Number of Children	0.076***	0.090***	0.084***	0.057***
Number of HH members	-0.034***	-0.043***	-0.036***	-0.023***
<i>Head of the Household level of education</i>				
Primary & Lower Secondary	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Upper Secondary	-0.036***	-0.071***	-0.031**	-0.010
Technical and Professional	-0.033***	-0.072***	-0.031**	-0.003
Higher	-0.042***	-0.066***	-0.043***	-0.018
<i>Mother level of education</i>				
Primary & Lower Secondary	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Upper Secondary	-0.003	-0.096	-0.026	0.006
Technical and Professional	-0.002	-0.091	-0.019	-0.002
Higher	-0.010	-0.102	-0.030	-0.007
<i>Wealth index quintile</i>				
Poorest	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Second	0.018***	0.021**	0.006	0.027**
Middle	0.017***	0.017*	0.012	0.028**
Fourth	0.012*	0.019	0.005	0.019
Richest	0.003	0.014	0.006	-0.001
<i>Ethnicity</i>				
Kazakh	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>

Russian	0.023***	0.019**	0.028***	0.013
Other ethnic groups	0.021***	0.023**	0.015	0.012
Urban	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Rural	0.009*	0.004	-0.006	0.024**
Regional dummies	YES	YES	YES	YES
Year dummies	YES	NO	NO	NO
Observations	28259	9497	9488	9274
Pseudo R2	0.240	0.248	0.294	0.203

Notes: Marginal effects. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

4. Conclusions

Kazakhstan has experienced an outstanding decrease of the infant mortality for neonatal and children under 5 years old. Several factors are behind these changes. Age of the mother shows a curvilinear relation with a lower risk increasing the age of the mother and a higher risk with the age to first children. Results show the access to health resources is the main determinant to reduce infant mortality. On the one hand, the probability that women had experienced the death of a child increases for the 2th and 3th quintile of wealth, i.e. for those who have better access to health resources. On the other hand, the probability that the child dies are higher for families living in rural areas compared with urban areas (explained for the difficulties of reaching the health facilities in rural areas). The social determinants as well as health system performance explains the major part of childhood health changes. In fact, there are many evidences about the relationship of socioeconomic status and health, since poor households share higher risk overall morbidity and mortality compared to their richer counterparts. In this sense, the improvements of average income per inhabitant in a country should also increase the average health of the population and particularly the kids less than 5 years old.

Our results that the level of education of the head of the household is more important than the maternal level of education to reduce infant mortality. This may be explained by the important role of the father parents in traditional families in Kazakhstan.

References

Arntzen, A., Magnus, P., & Bakketeig, L. S. (1993). Different effects of maternal and paternal education on early mortality in Norway. *Paediatric and perinatal epidemiology*, 7(4), 376-386.

Bakketeig & Homan, 1979

Boyle, M. H., Racine, Y., Georgiades, K., Snelling, D., Hong, S., Omariba, W., ... Rao-Melacini, P. (2006). The influence of economic development level, household wealth and maternal education on child health in the developing world. *Social Science and Medicine*, 63(8), 2242–2254. <https://doi.org/10.1016/j.socscimed.2006.04.034>

Breierova, L., & Duflo, E. (2004). The impact of education on fertility and child mortality: Do fathers really matter less than mothers? (No. w10513). National bureau of economic research.

Bobak, M., & Leon, D. A. (1992). Air pollution and infant mortality in the Czech Republic, 1986-88. *The Lancet*, 340(8826), 1010-1014.

Caldwell, J. C. (1993). Women's Position and Child Mortality and Morbidity in Less Developed Countries. || Pp 122-39 in Women's Position and Demographic Change, edited by N. Federici, K. O, Mason, and S. Sogner.

Chung, H., & Muntaner, C. (2006). Political and welfare state determinants of infant and child health indicators: an analysis of wealthy countries. *Social science & medicine*, 63(3), 829-842.

Chatterjee, M. (1990). A report on Indian women from birth to twenty. New Delhi: National Institute of Public Cooperation and Child Development.

Claeson, M., Bos, E. R., Mawji, T., & Pathmanathan, I. (2000). Reducing child mortality in India in the new millennium. *Bulletin of the World Health Organization*, 78, 1192-1199.

Cochrane, S. H., Leslie, J., & O'Hara, D. J. (1982). Parental education and child health: intracountry evidence. *Health policy and education*, 2(3-4), 213-250.

Flegg, A. T. (1982). Inequality of income, illiteracy and medical care as determinants of infant mortality in underdeveloped countries. *Population studies*, 36(3), 441-458.

Hanna Remes, Pekka Martikainen, Tapani Valkonen, The effects of family type on child mortality, *European Journal of Public Health*, Volume 21, Issue 6, December 2011, Pages 688–693, <https://doi.org/10.1093/eurpub/ckq159>

Ware, H. (1984). Effects of maternal education, women's roles, and child care on child mortality. *Population and Development Review*, 10, 191-214.

- Loomis, D., Castillejos, M., Gold, D. R., McDonnell, W., & Borja-Aburto, V. H. (1999). Air pollution and infant mortality in Mexico City. *Epidemiology*, 118-123.
- MacMahon, B., Kovar, M. G., & Feldman, J. J. (1972). Infant mortality rates; socioeconomic factors, United States.
- Morris SS, Carletto C, Hoddinott J, Christiaensen LJ. Validity of rapid estimates of household wealth and income for health surveys in rural Africa. *J Epidemiol Community Health* 2000;54:381–87.
- Muldoon, K.A., Galway, L.P., Nakajima, M. et al. Health system determinants of infant, child and maternal mortality: A cross-sectional study of UN member countries. *Global Health* 7, 42 (2011) doi:10.1186/1744-8603-7-42
- Saldiva, P. H., Lichtenfels, A. J. F. C., Paiva, P. S. O., Barone, I. A., Martins, M. A., Massad, E., ... & Bohm, G. M. (1994). Association between air pollution and mortality due to respiratory diseases in children in São Paulo, Brazil: a preliminary report. *Environmental research*, 65(2), 218-225.
- Smith J.P. 1999. Healthy bodies and thick wallets: The dual relation between health and economic status. *Journal of Economic Perspectives* 13: 145–166.
- Mosley W. H., Chen L. C. An analytical framework for the study of child survival in developing countries //Population and development review. – 1984. – T. 10. – №. 0. – C. 25-45.
- Maitra, P. (2004). Parental bargaining, health inputs and child mortality in India. *Journal of health economics*, 23(2), 259-291.
- Falkingham, J. (2003). Inequality and Changes in Women’s Use of Maternal Health-care Services in Tajikistan. *Studies in Family Planning*, 34(1), 32–43. <https://doi.org/10.1111/j.1728-4465.2003.00032.x>
- Falkingham, J. (2005). The end of the rollercoaster? Growth, inequality and poverty in Central Asia and the caucasus. *Social Policy and Administration*, 39(4), 340–360. <https://doi.org/10.1111/j.1467-9515.2005.00444.x>
- Feng, X. L., Theodoratou, E., Liu, L., Chan, K. Y., Hipgrave, D., Scherpbier, R., ... & Black, R. E. (2012). Social, economic, political and health system and program determinants of child mortality reduction in China between 1990 and 2006: a systematic analysis. *Journal of global health*, 2(1).
- Fuse, K. (2010). Variations in attitudinal gender preferences for children across 50 less-developed countries. *Demographic Research*, 23, 1031-1048.
- Filmer, D., & Pritchett, L. H. (2001). Estimating wealth effects without expenditure data—or tears: an application to educational enrollments in states of India. *Demography*, 38(1), 115-132.
- Susser, M. (1994). The logic in ecological: II. The logic of design. *American Journal of Public Health*, 84(5), 830–835. <https://doi.org/10.2105/AJPH.84.5.830>
- Stifel D, Sahn D, Younger S. Inter-temporal changes in welfare: Preliminary results from nine African countries. Ithaca: Cornell University; 1999 May.
- World Health Organization. (1999). The world health report: 1999: making a difference. World Health Organization..

