COULD INFANT MORTALITY ANALYSIS WITH TIME-INVARIANT COVARIATE EFFECTS BE MISLEADING? EVIDENCE FROM URBAN TURKEY

RESULTS

Mother's Age

Table x: Estimates of Mother's Age Variable by Age of the Infant

	15-19 Years Old			40-49 Years Old		
	Odds Ratio	St. Dev.	p-value	Odds Ratio	St. Dev.	p-value
Cumulative Regressions:						
1) First Week Period Only	1.516	0.649	0.331	2.551	0.843	0.005
2) First Month Period Only	1.522	0.570	0.263	2.214	0.680	0.010
3) First Year Period	1.511	0.459	0.174	1.916	0.468	0.008
Split Regression						
First Day	0.721	0.746	0.753	3.203	1.626	0.022
First Week after First Day	2.035	0.923	0.117	2.060	0.806	0.065
First Month after First Week	1.276	1.010	0.758	0.892	0.964	0.916
First Year after First Month	1.304	0.716	0.629	1.538	0.681	0.331

Notes: The baseline group is 20-to 39-years-old mothers.

According to cumulative analysis, young motherhood (at ages 15 to 19) increases the odds of mortality by a factor of 1.5 at early-neonatal, neonatal, and infant levels; however, none of these is statistically significant at the conventional levels due to large standard errors. The split analysis reveals important differences in the point estimates according to the time-intervals: the point estimate for the first week after the first day is especially high and close to being statistically significant at the 10 percent level; according to this estimate, young mothers face an odds of mortality that is 2 times as much as that for mothers aged 20 to 39.

There is very strong statistical evidence that an older age of motherhood is associated with a higher early neo-natal, neo-natal as well as infant mortality. Moreover, the magnitude of this association is also quite large: old motherhood increases the odds of early neo-natal mortality by a factor of 2.55 and the odds of infant mortality by a factor of 1.92. Again, when we split the time intervals, we find important differences. Old motherhood increases the odds of mortality in the early neo-natal period, especially in the first 24 hours. In fact, in the first 24 hours, the odds of mortality is 3.2 times as much for older mothers compared to the baseline group (20- to 39-years-old mothers); and in the first week after the first 24 hours, the odds of mortality is more than 2 times as much for older mothers. On the other hand, there is no evidence at all that children of older mothers face a higher risk of mortality after the first week of their lives.

This finding highlights the importance of conducting a split-time analysis rather than a cumulative analysis. It is possible to investigate the relationship between certain socioeconomic factors and mortality of children at early neo-natal, neonatal, and infant levels separately as it is done above. However, the factors that have important associations with mortality at early neo-natal and neo-natal levels carry on to the infant level even though some of these factors become unimportant in the postnatal period or even earlier (after the first week.) For instance, above we find an important association between old motherhood and infant mortality even though old motherhood has virtually no relationship with mortality after the first week of the child. This fact is uncovered by the split-time analysis, which would not be possible with cumulative analysis.

Mother's Education

Table x: Estimates of Mothers' Years of Schooling Variable by Age

	Odds Ratio	St. Dev.	p-value
Cumulative Regressions:			
1) First Week Period Only	0.931	0.031	0.034
2) First Month Period Only	0.931	0.028	0.020
3) First Year Period	0.949	0.023	0.034
Split Regression			
First Day	0.975	0.049	0.630
First Week after First Day	0.931	0.037	0.078
First Month after First Week	0.924	0.068	0.289
First Year after First Month	0.955	0.041	0.297

According to cumulative analysis, mother's schooling is associated with mortality at all levels: early neo-natal, neonatal, and infant. (The statistical significance is at the 5 percent level for all durations.) An extra year of schooling decreases the odds of infant mortality by 5 percent.

In the split time analysis, although the significance levels drop substantially, this is completely due to growing standard deviations (standard deviations in the split-time analysis are larger because there are fewer data points per interval). The point estimates in the split analysis—except for that for the first day—are very similar to those in the cumulative analysis; i.e., the importance of mother's years of schooling is preserved. Not surprisingly, mother's schooling matters less in mortality in the first day.

Birth Order

Table x: Estimates of Birth Order Variable by Age

	First Child				Fifth or Later Child		
	Odds Ratio	St. Dev.	p-value		Odds Ratio	St. Dev.	p-value
Cumulative Regressions:							
1) First Week Period Only	1.501	0.343	0.076		1.849	0.495	0.022
2) First Month Period Only	1.404	0.286	0.096		1.569	0.379	0.062
3) First Year Period	1.354	0.227	0.070		1.472	0.270	0.035
Split Regression							
First Day	1.132	0.428	0.743		1.530	0.681	0.339
First Week after First Day	1.799	0.509	0.038		2.295	0.722	0.008
First Month after First Week	1.146	0.527	0.766		0.656	0.406	0.497
First Year after First Month	1.251	0.377	0.458		1.231	0.362	0.480

Notes: The baseline group is second- to fourth-born children.

According to the cumulative analysis, first-born children face a higher early neo-natal, neo-natal as well as infant mortality risk compared to second- to fourth-born children. (The statistical significance is at the 10 percent level.) For instance, during the early neo-natal period, the odds of mortality are 1.5 times as much. However, in the split-time analysis, there is evidence only in the first week after the first day (statistically significant at the 5 percent level) that first-born children face higher odds of mortality; in fact, it is 1.8 times higher for first-born children at this period. On the other hand, there is no evidence for the other periods in the split-time analysis that first-born children face a higher mortality risk. This is not only due to higher standard errors; the point estimates are much lower as well. Therefore, we can claim that the higher neo-natal as well as infant mortality risk of first-born children is driven mostly by their higher mortality risk in the early neo-natal period after the first 24 hours.

For later-born children (fifth or later), there is also evidence that there is a higher risk in early neo-natal, neo-natal as well as infant mortality. (The evidence is statistically significant at the 5 percent level for early neo-natal and infant mortality and at the 10 percent level for neo-natal mortality.) For instance, the odds of mortality are 85 percent higher for later-born children compared to second- to fourth-born children in the early neo-natal period, and 47 percent higher in the whole infancy period. In the split-time analysis, while there is no evidence at all of a higher mortality risk for later-born children after the first week of their life, their risk of mortality is much higher in the early neo-natal period and in particular after the first day of the neo-natal period: in this period, being later-born is associated with an almost 130 percent increase in the odds of mortality. In the first 24 hours, being later born is also associated with an important rise in the odds of mortality, by a factor above 1.5; however, this is imprecisely estimated. In essence, the split-time analysis reveals that the association between being later-born and infant as well as neonatal mortality arises mostly due to the relationship between these variables in the early neo-natal period.

Short Preceding Birth-Interval (Less Than 24 months)

Table x: Estimates of Short Preceding Birth-Interval Variable by Age

	Odds Ratio	St. Dev.	p-value
Cumulative Regressions:			
1) First Week Period Only	2.085	0.468	0.001
2) First Month Period Only	1.833	0.373	0.003
3) First Year Period	1.929	0.303	0.000
Split Regression			
First Day	2.376	0.858	0.016
First Week after First Day	2.149	0.584	0.005
First Month after First Week	1.001	0.510	0.998
First Year after First Month	1.879	0.476	0.013

There is strong evidence (statistically significant at the 1 percent level) that a short preceding birth interval is associated with a higher early-neonatal, neo-natal as well as infant mortality risk. For instance, a short preceding birth interval is associated with a more than 100 percent increase in the odds of early neo-natal mortality, and with a 93 percent increase in the odds of infant mortality.

In the split-time analysis, this finding is preserved at all time-intervals, but for the first month after first week; i.e. the importance of a short preceding birth-interval for neo-natal mortality is driven from its importance in the early neo-natal period. In particular, the association is very strong in the first day: a short birth-interval is associated with a rise in the odds of mortality by a factor of 2.4.

Prenatal Care

Table x: Estimates of Prenatal Care Variable by Age and Number of Visits

	Prenatal Care				Frequent Prenatal Care (4 or More Visits)		
	Odds Ratio	St. Dev.	p-value		Odds Ratio	St. Dev.	p-value
Cumulative Regressions:							
1) First Week Period Only	1.003	0.270	0.990		1.111	0.307	0.704
2) First Month Period Only	0.925	0.218	0.742		0.899	0.221	0.665
3) First Year Period	0.720	0.130	0.070		0.714	0.137	0.079
Split Regression							
First Day	1.183	0.558	0.722		1.670	0.781	0.272
First Week after First Day	1.053	0.333	0.868		1.067	0.355	0.844
First Month after First Week	0.689	0.338	0.448		0.346	0.199	0.065
First Year after First Month	0.457	0.138	0.010		0.427	0.141	0.010

Notes: Frequent prenatal care coefficients are calculated as linear combinations of the "prental care" and "frequent prenatal care" variables (as both variables take the value of 1 in the case of frequent prenatal care) in Tables A1 and A2.

The cumulative analysis reveals no relationship between prenatal care and early neo-natal or neo-natal mortality; however, there is evidence, statistically significant at the 10 percent level, that prenatal care is related to infant mortality. In fact, prenatal care is associated with a 28 percent drop in infant mortality. This is regardless of the frequency of prenatal care: the magnitude of the estimated association is very similar for frequent prenatal care as well.

The split-time analysis reveals a much stronger relationship between prenatal care and postnatal mortality. Both the statistical significance and the magnitude of the association is larger: the statistical significance rises to the 1 percent level and prenatal care that is taken fewer than 4 times is associated with a 54 percent drop and prenatal care that is taken 4 or more times is associated with a 57 percent drop in the postnatal mortality rate.

Moreover, even though the cumulative analysis indicates no relationship between prenatal care and neonatal mortality, according to the split-time analysis, there is evidence at the 10 percent statistical significance level that frequent prenatal care (4 or more times) is associated with a 65 percent drop in the odds of mortality in the last three weeks of the neonatal period.

Place of Delivery

Table x: Estimates of Delivery at a Health Facility Variable by Age

	Odds Ratio	St. Dev.	p-value
Cumulative Regressions:			
1) First Week Period Only	0.792	0.190	0.335
2) First Month Period Only	0.911	0.197	0.668
3) First Year Period	0.715	0.117	0.041
Split Regression			
First Day	0.806	0.321	0.589
First Week after First Day	0.879	0.254	0.656
First Month after First Week	1.678	0.876	0.321
First Year after First Month	0.435	0.115	0.002

According to the cumulative analysis, there is evidence (statistically significant at the 5 percent level) of an association between delivery at a health facility compared to delivery at home and infant mortality: delivery at a health facility is associated with a 28 percent fall in the odds of infant mortality. However, no such correlation exists at neonatal or early neo-natal levels. However, a further analysis using the split-time model reveals that the relationship between delivery at a health facility and infant mortality is driven mostly by this relationship during the postnatal period: during this period, delivery at a health facility is associated with a 57 percent decline in the odds of mortality. (The statistical significance is at the 1 percent level.) The magnitude of this association is also much larger than that found for the whole infancy period in the cumulative regression (57 percent instead of 28 percent decrease). In earlier periods of infancy, there is no evidence of a relationship between place of delivery and mortality of the child.

Other Evidence

Family wealth, gender of the child and ethnicity of the child (Turkish, Kurdish, other) are not associated with mortality at any time period in the split-time analysis or in any of the cumulative regressions. However, there is evidence that children born in Southern or Northern Turkey face a lower risk of mortality in the first week after the first day compared to children born in the Western Region. Moreover, in the cumulative analysis, there is a lower risk for children born in the Southern Region compared to those born in the Western Region both in early neo-natal and neo-natal mortality. Finally, as expected, calendar-year dummies turn out to be important both in split-time and cumulative regressions.

Conclusion

This study investigates whether the usual practice of conducting infant mortality analysis with time-invariant covariate effects could be misleading. For this purpose, it compares the results of an infant mortality analysis that does not allow for time-invariant covariate effects with the results of one that allows. This comparison reveals that the effects of many covariates change substantially by the age of an infant. Moreover, in addition to the infant mortality analysis with time-invariant covariate effects, separate neo-natal and early neo-natal mortality analyses that also have time-invariant covariate effects are conducted to examine whether the time-variant covariate effects could be observed in this way. The results show even this method cannot uncover certain changing covariate effects over the age of the infant, which are uncovered by the infant mortality analysis with time-variant covariate effects.

This is best illustrated in this study with regard to the relationship between late motherhood and infant mortality. All early neo-natal, neo-natal, and infant mortality analyses with time-invariant effects show that late motherhood is highly associated with mortality. However, the split-time analysis that allows for time-variant effects reveals no evidence of an association between late motherhood and mortality after the first week of children. The significant association in the neo-natal as well as infant mortality analyses with time-invariant effects arises because of the strong relationship in the early neo-natal period.

Similarly, first-born and later-born (fifth or later) children face a higher risk of mortality according to all infant, neo-natal, and early neo-natal analysis with time-invariant effects. However, the split-time analysis with time-variant effects shows no evidence of a relationship after the first week of a child's life; the strong relationship during the early neo-natal period dominates in the neo-natal and infant mortality analysis with time-invariant effects. Moreover, the relationship that is established in the early neo-natal period is mainly driven by the relationship after the first 24 hours of the early neo-natal period.

Another novel feature of our analysis is our inclusion of the first 24 hours as a separate interval in our split-time analysis with time-variant effects. The results show that a short preceding birth-interval is associated with a 140 percent increase in the odds of mortality in this first day of a child's life; this is stronger than the relationship between a short preceding birth-interval and mortality in later periods of the infants' life. In addition, the split-time analysis also indicates that old motherhood is strongly associated with mortality within the first 24 hours.

Given the scarce financial resources that can be devoted to prevent infant mortality in developing countries, it is quite important to use these resources effectively. The effective use of these resources, in turn, requires the knowledge of where to invest these resources as well as the timing of the investment. The findings of this paper highlight the importance of the timing of these investments. For instance, in the Turkish context, while it is important to address high-risk groups like the children of older mothers as well as first-born children, it is at the same time important to know these groups have higher risk only in the early neo-natal period, but not afterwards. Therefore, additional resources spent on these groups after the first week would result in inefficient use of resources.