Evaluation of the Impact of the Mother and Infant Health Project on Maternal and Infant Health Outcomes in Ukraine

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Abstract

This paper exploits a unique opportunity to evaluate the impact of improvement in the quality of prenatal care and labor and delivery services on maternal and infant mortality and morbidity. Since basic medical care has been universally available in Ukraine, implementation of the Mother and Infant Health Project allows addressing quality rather than quantity effect of medical care. Employing program evaluation methods we find that the administrative units (rayons) participating in the Project have exhibited greater improvements in both maternal and infant health compared to the control rayons. Among the infant health characteristics, the MIHP impact is most pronounced for stillbirths and infant mortality and morbidity resulted from deviations in perinatal period and congenital anomalies. As for maternal health, the MIHP is the most effective at combating anemia, maladies of blood circulation, veins, and urinary-genital complications, as well as late toxicosis. The analysis suggests that the effects are due to early attendance of antenatal clinics, lower share of C-sections, and greater share of normal deliveries.

1 Introduction

Infant mortality/morbidity has often been a focus of health economics and medical research as a major indicator of a country's well-being, while maternal health outcomes have been much less investigated. Several reasons are to be named for such a development. One is that the rates of maternal deaths are quite low in developed countries. And the second is attributed to the difficulty of measuring maternal health outcomes, the problem that is most severe in developing countries. Nevertheless, the issue of maternal health attracts considerable attention of society due to the fact that most of maternal deaths and health deteriorations are preventable. Moreover, recent evidence demonstrates that improvements in health outcomes for mothers and infants are related not as much to the availability of care (structural quality), but to the way this care is provided (process quality) (Barber & Gertler 2002). Furthermore, some studies find that access to low quality providers in fact contribute to higher child morbidity and mortality (Sodemann, Jakobson, Molbak, Jr. & Aaby 1997).

Notwithstanding the importance of the matter studies of the impact of quality of prenatal care and labor and delivery services on maternal and infant health outcomes are quite rare: it is difficult to find a setting that allows separation of quality from quantity dimension. This paper contributes to this literature analyzing the impact of exogenous change in the quality of prenatal care and labor and delivery services caused by the Mother and Infant Health Project (MIHP). Ukrainian setting creates a unique opportunity for an identification of this quality impact: (i) unlike the situation in developing countries (where health initiatives come together with new facilities), participation in the Project has changed only quality dimension of service, since the basic prenatal and obstetrics care is universally available; (ii) unlike the sit-

uation in developed countries (where population health compares favorably to the rest of the world), the level of maternal and infant health outcomes is quite poor leaving enough room for improvement; (iii) every maternity reports information on maternal and infant health outcomes to regional health administration. In addition the study investigates the mechanisms through which the reductions in the infant and maternal mortality and morbidity takes place via estimating the impact of the MIHP on prenatal care use, intermediate health outcomes and mortality components.

Using difference-in-difference methodology it is found that the MIHP participating rayons observe greater improvements in maternal and infant health. The results indicate that improvements in maternal morbidity (lower prevalence of anemia, blood circulation system, veins, and urinary-genital complications) and mortality may be due to earlier attendance of prenatal clinics, increased rate of normal deliveries, and reduction in rate of C-sections. The same channels may be leading to improvements in infant health: the MIHP participation significantly reduces total infant mortality and stillbirths, as well as mortality and morbidity resulted from deviations in perinatal period and congenital anomalies.

The paper is structured as follows. Next section describes the system of health care in Ukraine, the Mother and Infant Health Project, and provides an overview of related literature. Section three focuses on the empirical methodology followed by the descriptive analysis in Section four. Basic estimation results are offered in Section five. Section seven follows with the robustness checks and discussion.

2 Background

2.1 Health Care System and Maternal Health Services in Ukraine

The right for free health care is one of the basic Constitutional rights in Ukraine (Article 49). And, although the informal payments are widespread (Allin, Davaki & Mossialos 2005), certain set of basic services can be rendered by patients for free, and this is most evident with respect to maternal and infant care. Majority of the health care establishments are publicly owned and are subordinated to regional administration. By the end of 2000, Ukraine has had more than 24 thousands of health care facilities, including various support units like medical statistical centers, medical treatment facilities, spas, health resorts, blood transfusion centers etc. At the same time only about six thousand individuals and about one thousand of legal entities are licensed to practice medicine independently (Lekhan, Rudiy & Nolte 2004). According to the same source, only about 2% of the population has medical insurance, although this number has been growing with improvement of the economic conditions up to year 2008. However, this trend is likely to reverse in the face of the current economic crisis. According to the Ministry of Health Report the overall health care financing in year 2007 comprised 3.9% of the GDP compared to the 3.3% in year 2006 (MHCU 2007), which is considerably lower than in the EU and Eastern European countries.

The network of reproductive facilities consists of maternities (approximately one per rayon) and women's clinics (about 1-3 per rayon) as well as numerous pediatric clinics. Women's clinics specialize in antenatal care including (i) monthly patronage of pregnant women, (ii) routine tests (blood, pressure, and urine) and measurements (weight and height), (iii) prevention of complications during pregnancy, and (iv) family planning counseling. Rayon

maternities address delivery and postpartum issues, while oblast maternities focus on complicated labor and delivery cases (those with severe anemia, diseases of genital-urinary system, blood circulation system, etc.). Pediatric clinics provide regular infant care including vaccination and routine monitoring in the first year of life and thereafter as needs arise.

2.2 Mother and Infant Health Project Description

The Mother and Infant Health Project (MIHP) is an eight-year project advocating evidence-based medical practices aimed at improvement of women's reproductive and newborn health. The first phase of the project has been initiated in September 2002 in four regions of Ukraine, but first maternities have actually joined the Project in mid-December 2003. By the end of 2006 the Project expanded to 20 maternity hospitals in twelve pilot regions. Following the Millennium Development Goals for the country (MEU 2005), MIHP pioneers to introduce new evidence-based medicine (EBM) standards - developing family-friendly delivery rooms, reducing practices such as unnecessary C-sections, amniotomies, and episiotomies, as well as increasing the use of free position during delivery, immediate skin-to-skin contact, early breastfeeding, and the rooming-in of mothers and newborns. In addition the Project actively supports the provision of trainings on effective perinatal technologies for the staff of the MIHP maternities, development of "centers of excellence" that serve as models in training/education of the medical practitioners of the corresponding oblast, and organizing health awareness campaign on healthy lifestyles.

MIHP also aims to reinforce liaisons with the local governmental institutions. The project introduces new EBM standards for mother and newborn health care, with a stronger focus on integration of these standards into a

package of perinatal practices in Ukraine. It also targets revising current curricula for medical universities and colleges in order to increase the evidence base of educational programs for medical students and health care providers.

2.3 Related Literature

Although it is obvious that the determinants of maternal and infant health are closely related, there are very few works where the issue of maternal and infant health is considered jointly (Winikoff 1988). Moreover, most of the economic literature (both theoretical and empirical, likewise in developed and developing countries) has focused on infant health almost completely ignoring the issue of maternal health. Similar trend has been observed in the medical literature. Two reasons are to be named for such a phenomena. One is that the rates of maternal death are quite low in developed countries. And the second is attributed to the difficulty of measuring maternal health outcomes, especially in developing countries. Nevertheless, even in the developed nations with their low maternal mortality ratios (which are 2-3 time lower than those in Ukraine) this issue draws considerable attention due to the fact that most of these rare deaths are preventable. Moreover, as Haas, Udvarshelyi & Epstein (1993) claims "60 percent of women receive medical care for some complication of pregnancy and 30 percent suffer complications that result in serious morbidity" (as cited in Karen & Kutinova (2006)).

MIHP is a program that targets the quality of the provision of the labor and delivery services directly as well as the quality of prenatal care indirectly since most of the obstetricians in Ukraine are having joint appointments in the maternities and antenatal clinics. Therefore the expected impact of the MIHP on the outcomes of interest can be inferred from the evaluations of im-

pact of antenatal care, as well as labor and delivery services. Antenatal care can reduce maternal mortality and morbidity both directly, through detection and treatment of pregnancy-related or intercurrent illnesses, and indirectly, through detection of women at increased risk of complications of delivery and referring them to a suitably equipped facility (Oxaal & Baden 1996). Analysis of historical data shows that a significant fall in the maternal mortality ratios in the UK and USA can be attributed to improved obstetric care. In particular, Carroli, Rooney & Villar (2001) emphasize that better delivery care significantly reduce maternal mortality from infections and hemorrhage. Laditka, Laditka, Mastanduno, Lauria & Foster (2005) in turn suggest that adequate prenatal care may reduce potentially avoidable maternity complications. However, other authors underline that the impact of the antenatal care and/or certain interventions during pregnancy is more difficult to assess due to a large number of confounding factors not observed by researchers (Carroli *et al.* 2001). Out of the socio-economic factors, only income has been identified as a significant determinant in reducing the probability of having a complication (Laditka *et al.* 2005). In turn, Furuta & Salway (2006) find that spousal discussion of family planning, women's secondary education, and female employment are positively linked to the likelihood of receiving antenatal care.

It is common in health economics research to find little or no effect of the prenatal care use on the infant health, in particular the low birth weight. Conway & Deb (2005) explain this by the fact that looking at all births simultaneously may obscure the effect of prenatal care on "normal" births. According to the medical literature some of the births result in poor outcomes due to bad maternal behavior or poor fetus condition to begin with and cannot be remedied by any prenatal care intervention. Therefore, lack of

significant impact of prenatal care on infant health may be explained by data that does not discriminate between "normal" and "problematic" pregnancies. In addition, lack of the impact may be due to selection. Mothers anticipating poor birth outcomes are more likely to seek more antenatal care and seek it earlier while still having poorer than average outcomes. Authors that use exogenous variation in prenatal care, such as "natural experiment", find positive and significant impact of prenatal care use on birth outcomes (Evans & Lien 2005).

Another determinant of infant health outcomes usually receiving a lot of attention from researchers is health care spending. The evidence from a cross-country study of developing countries suggest that the health care spending has no significant effect on child mortality while the access to health care and the mother and infant health program effort has a significant negative impact as does the percentage of births attended by trained personnel. The reason for the lack of effect of the spending on mortality may be due to the fact that the maternal and infant health care interventions that are most effective in reducing child mortality are so inexpensive that "they do not even show up in data on ... public spending" (McGuire 2006).

Similarly Bhalotra (2007) finds of no effect of health care spending. However, when investigating separately the effect on poor and rural households, spending does play a role in improving infant health for those groups. This and other studies also show that infant and child mortality and morbidity are determined by poverty and unemployment rate (Currie & Grogger 2000), parental education, urban residence, and maternal health (Buckley 2003, Chou, Liu, Grossman & Joyce 2007). On the contrary, Goldman & Grossman (1982) find that health care spending and public policy programs in the US do have a significant impact on infant mortality, and ar-

gue that this impact runs through improvements in health of mothers, rather than the use of prenatal care per se.

Current study contributes to the literature in two ways: (i) by evaluating causal impact of quality of prenatal and obstetric care, and (ii) by studying the mechanism through which the effect takes place.

3 Empirical Strategy

Preliminary insider assessment of the Project shows positive trends in maternal and infant health outcomes in the participating maternities along various dimensions: use of individual delivery rooms, companion presence, level of C-sections and episiotomies, neonatal mortality and morbidity, etc. However, this insider monitoring does not allow identifying the real effect of the treatment for two reasons. One is that this assessment takes into account outcomes only at the participating maternities, but the Project may have a spillover effect on the neighboring community, in which case the insider assessment would give an underestimate of the true effect. The other reason is that analyzing the data at the site of treatment does not allow separating the effect of the Project from the changes in the outcome measures due to other confounding factors, in which case it would be an overestimate or underestimate of the true effect depending on the sign of the correlation between the confounding factors, the treatment variable, and the outcome.

Theoretically maternal and infant health (Karen & Kutinova 2006) depends on health inputs, including such intermediate determinants as prenatal care and access to health services (McCarthy & Maine 1992), mother and infant health endowments, and socio-economic characteristics (distant determinants). However, in the empirical specification we omit all of these variables

to avoid over controlling.[1] The simplest estimator used to evaluate the effect of the MIHP participation (treatment effect) is a difference-in-difference estimator (DD) and the empirical model takes the following form:

$$H_{rt} = \beta_0 + \beta_P P_{rt} + T_t\beta_t + R_r\beta_R + T_tO\beta_{to} + u^0_{rt}, \quad (1)$$

where health outcome H in region r at time period t depends on treatment P. Overtime changes in health outcomes are compared between the MIHP participating rayons and the control rayons netting out the common time trend T_t, rayon-specific fixed effects R_r, and oblast-specific time effect T_tO since all medical institutions are subordinated to and financed by oblast-level authorities.

In such a setting, the estimate of β_P for the treatment dummy gives us the difference-in-difference (DD) estimate of the treatment effect of the MIHP participation. However, this estimate may be biased due to potential contamination of the control group. This contamination is quite likely since the MIHP sites are required to provide trainings to the personnel of all maternities of the oblast where the site is located. Thus, the model is augmented by a variable that could capture the impact of these trainings:

$$H_{rt} = \beta_0 + \beta_P P_{rt} + \beta^{tr}_P P^{tr}_{rt} + T_t\beta_t + R_r\beta_R + T_tO\beta_{to} + u^0_{rt}, \quad (2)$$

In this case β^{tr}_P picks up the effect of trainings only and represents the lower bound of the MIHP impact.

The estimates of the MIHP impact presented above provide the average

[1]The analysis has been performed including the full list of controls (total population morbidity, number of Chornobyl-related diseases, doctor's load, number of obstetricians, number of midwives, share of deliveries to women aged 18-34, share of first deliveries, number of colleges and universities interacted with time, logarithm of real average wage, share of employed among working age population, per capita air pollution, ratio of divorces to marriages, number of families getting utility subsidies) showing no impact on the results.

treatment effect across all the MIHP participating rayons compared to the control rayons. However, this approach is subject to several criticisms. First of all, it does not allow for heterogeneity of treatment since various components of the Project may be implemented in stages. Second, it does not account for a possibility that the Project impact may depend on the duration of participation. Finally, it does not refute the possibility that the participating maternities have been systematically different from the control group prior to the treatment and whether this difference has an impact on the validity of the Project impact estimates. To tackle these issues the MIHP indicator in Equation 1 has been replaced with a set of variables reflecting the timing of the Project implementation: (T_{-3},T_{-2},T_{-1},T_1,T_2,T_3). All these variables are equal to zero for the control group outcomes and 1 for the treatment group at various stages of the Project implementation: three years before, two years before, one year before, one year after the Project start-up, two and more years after respectively.

However, there still exists a possibility that the resulting estimates may not reflect the true treatment effect, since the rayons might have experienced other health affecting initiatives implemented simultaneously with the MIHP. Thus, the estimated treatment effect of the MIHP would be upward-biased if other initiatives' influence on maternal and infant health outcomes is positive and downward-biased otherwise. Triple difference procedure is usually used in the literature to address this problem. However, it is impossible to directly apply it in the current setting since most of the outcomes used in the study are related to infants and females of fertile age. Consequently, two alternative estimation procedures are utilized as tests for the validity of the DD strategy.

The first procedure applies the model described in Equation (1) to the pregnancy unrelated (placebo) outcomes (e.g. prevalence of diabetes, hep-

atitis, etc.). Statistically and economically insignificant treatment effect on those outcomes would confirm the validity of the DD estimates of the MIHP impact on pregnancy related outcomes. The second procedure applies to the set of outcomes which are collected for the whole rayon population but can potentially be affected by the Project (e.g. hypertension). In this case it is possible to apply the DDD procedure with a slight modification of the suggested empirical model:

$$H_{rt} = \beta_0 + \beta_{PF} P_{rt} F_{rt} + \beta_P P_{rt} + \beta_F F_{rt} + Z_{rt}\beta_Z + S_{rt}\beta_S + M_{rt}\beta_M + \qquad (3)$$

$$+\beta_{RF} R_r F_{rt} + \beta_{TF} T_t F_{rt} + \beta_{TR} T_t R_r + T_t\beta_t + R_r\beta_R + u^0_{rt},$$

where F_{rt} is the percentage of female population of fertile age. In this case the coefficient β_{PF} is the triple difference estimate of the MIHP treatment effect.

Outcome Variables. There are three groups of outcome variables to be evaluated: maternal, infant, and pregnancy-unrelated health outcomes (see Table 1). Bearing in mind difficulties that exist with the measurement of maternal mortality (Shiffman 2000) stemming from the erroneous attribution of the cause of death, the emphasis in the current paper is put on the less arguable maternal health outcomes which can be plausibly attributed to changes in the quality of labor and delivery services. In addition to the health outcomes, we estimate the impact of the MIHP on intermediate factors, such as early onset of antenatal care, rates of C-sections and normal deliveries which are related to the MIHP goals and are supposedly positively correlated with the maternal and infant health outcomes.

Treatment Variables The treatment effect is represented by (i) dummy variable that takes the value of one if the new perinatal center is opened in a rayon, (ii) "spillover" dummy equal to one if an MIHP center is opened in any rayon of a particular oblast, and (iii) a set of variables reflecting the time before and after the start-up of the Project in the treatment rayons. The first group of dummies identifies the influence of the MIHP centers within administrative units covered by the program. The second group reflects possible improvement of maternal and infant health resulted from the MIHP training for the oblast medical practitioners.[2] And the third one aims at catching possible differences between the treatment and control group prior to the Project implementation and the effect of exposure to the MIHP's promoted modes of service delivery over time.

All specifications include one additional control variable which indicates whether other programs that may have an impact on maternal and infant health are being implemented in a rayon in a particular year. It should be mentioned that these programs are rather different from the MIHP. Most of them are associated with significant financial contributions, provision of new expensive equipment, etc., while the MIHP emphasizes low cost of quality improvements. This makes it absolutely necessary to control for the effect of these other programs and attempts to compare it to the MIHP impact.

4 Data and Descriptive Analysis

Since all of the treatment rayons are urban, the sample is constrained to urban rayons (i.e. those that have at least one town or city). This results into

[2]Since the trainings are co-sponsored by the MIHP and an oblast administration, the trainings are limited to the staff of the MIHP maternities as well as to medical practitioners of MIHP oblasts.

an unbalanced sample of about 13 treatment and 227 control rayons.[3] The data is obtained from the oblast Centers of Medical Statistics (CMS) which collect periodic administrative reports from all health care establishments on a routine basis. Existing gaps in the data do not exhibit any systematic patterns, since they are mostly due to the difficulties of locating records at the CMSs, unrelated to the willingness of maternities not to report certain types of outcomes. The analysis covers the pre-treatment 2000-2002 and the post-treatment 2003-2006 periods.[4]

The restriction of the sample only to urban rayons serves several purposes. First, it allows matching the treatment rayons to more comparable control rayons, since no rural rayons have participated in the MIHP. Second, rayons are more homogeneous compared to the larger administrative/geographic areas and therefore the aggregated statistics is more reliable. Third, rayons with urban settlements are large enough to make it less likely that the individuals living in the area would seek care outside the rayon.[5]

Sample Description. Rayons that joined the MIHP are in general characterized by poorer population health outcomes, including maternal and infant health in the pre-treatment period (Table 2): higher infant morbidity and higher infant mortality - stillbirths and infant mortality and morbidity resulted from deviations in perinatal period and congenital anomalies. With

[3]Administratively, Ukraine consists of 25 large units - "oblast" - (including the Autonomous Republic Crimea), and 2 cities of the country subordination (Kyiv and Sevastopol). An oblast consists of about 13-46 small administrative units - "rayons". Rural units as well as small towns are subject to rayon governance, while big towns and cities are subordinated to an oblast. Hence, the data on towns of rayon subordination is included into a rayon statistics, while cities and towns of oblast subordination are reported separately.

[4]Although the MIHP project has started in September 2002, the first four maternities have joined the MIHP on December 10, 2003. Since many of the outcomes, e.g. rate of C-section, could be impacted immediately, we consider 2003 as the first year of the treatment.

[5]To test the last argument, a robustness check for the whole range of outcomes is performed on a set of rayons that consist of oblast-subordinated cities (metropolitan areas). Qualitatively results are similar, but quantitatively they are much stronger for metropolitan areas.

respect to maternal health, the pre-treatment period reveals the following situation. The MIHP rayons have been on average better off with respect to overall maternal mortality ratios and the registered cases of anemia in year 2000. However, in terms of maternal morbidity the non-MIHP rayons compare more favorably to the treatment rayons with more cases of morbidity due thyroid gland (9 vs. 17 percent in MIHP rayons) and late toxicosis (8 vs. 12 percent). The MIHP rayons in the pre-treatment period are comparable to the control rayons in terms of early attendance of antenatal clinics by pregnant women, but are considerably worse off with respect to the share of C-sections (12 vs. 7 percent) and normal deliveries (27 vs. 37 percent). The situation is similar with respect to infant health: total infant mortality and infant morbidity are considerably worse off in MIHP rayons in year 2000.

Despite the pessimistic pre-program health conditions, after the implementation of the Project the majority of the maternal and infant health outcomes have improved. Over the period from 2000 to 2006 we observe a sharp decrease in maternal mortality (from 24 to 4 in MIHP rayons) and a drastic decline of the full set of maternal morbidity indicators. The rate of normal deliveries in the MIHP sites have increased twice, while in non-program territories the increase of these indicators do not exceed 60%. As to the infant health, the infant mortality rate, which initially exceeded the non-MHIP indicator by 2, has declined from about 14 to 9 cases per 1000 livebirths; and the rate of stillbirths, increasing in control regions, has declined in the MIHP sites.

5 Estimation Results

Maternal Health. First part of Table 3 shows the impact of the MIHP on the maternal health outcomes. The treatment variable is measured as an indicator equal to one for the MIHP participating rayons in all time periods after they joined the Project. Therefore, the estimated coefficient shows average treatment effect for all MIHP-participating rayons in all periods. As could be seen from column (1), the difference-in-difference estimate of the MIHP impact is positive for most outcomes, including intermediate ones: women in the MIHP participating rayons are more likely to have normal deliveries and less likely to have C-sections. With respect to complications, mothers in the MIHP-participating rayons are less likely to experience anemia, problems with the blood circulation system, veins, as well as late toxicosis.

Potential problem with the estimate of the MIHP effect would have arisen in case if the MIHP participating maternities after joining the Project would have started selecting less complicated pregnancies, ensuring better outcomes simply by the composition of the patients. However, as evidence suggests, most of the MIHP maternities have been so called oblast maternity centers, which are specially designated to deal with high risk pregnancies and therefore are legally obliged to admit all high risk referrals from the surrounding areas.

Infant Health. As could be seen from the lower part of Table 3, the MIHP impact on infant mortality and stillbirths is negative and statistically significant. The evidence suggests that most of this effect is contributed by the impact of the MIHP participation on the infant mortality due to deviations in the perinatal period and congenital anomalies. The lower part of the table presents the estimates of the MIHP impact on infant morbidity. No significant treatment effect is found for total infant morbidity. However, infant

morbidity due to deviations in perinatal period has decreased faster in the treated rayons. The effect is quite large in magnitude - average treatment effect is a 16 percent decline compared to the baseline value of the outcome (-0.51 reduction from 3.25 diseases per 100 infants in year 2000).

6 Robustness Checks and Discussion

Effect of MIHP Trainings. Columns (3) through (5) in Table 3 show the estimates from the maternal and infant health regressions including the spillover effect on the same oblast maternities which can be interpreted as the effect of the MIHP trainings, the lower bound of the overall MIHP impact. As could be seen, the MIHP impact in Column (3) becomes stronger what is expected in the case of addressing the issue of contamination of the control group. At the same time, for all outcomes for which the earlier MIHP impact estimates have been significant there exists a significant effect of trainings, although it is about twice smaller in magnitude. The situation is somewhat different for infant health and maternal mortality. As could be seen better separation of the partially affected rayons from the control group allows identification of additional effects and vanishing of earlier findings. For example, the effects on total infant mortality and stillbirths become statistically insignificant, while maternal mortality shows significant decrease due to MIHP.

MIHP Effect Over Time. As Tables 4-5 in most cases there is no significant difference between treatment and control rayons in the years prior to the Project implementation. This points to the causality of the MIHP impact with respect to most of maternal and infant health outcomes.

Another dimension that the reported estimates uncover is the dependence

of the MIHP impact on time. For example, share of normal deliveries increases in the year of the Project start-up, the increase is even more pronounced in the year after and vanishes after that. The situation is different for anemia prevalence - the positive effect is becoming stronger over time.[6]

MIHP Effect on Placebo Outcomes. Table 6 presents the estimates of the impact of the MIHP participation on placebo outcomes. As the estimates show, no statistically significant effect is observed for the number of diagnosed cases of hepatitis and diabetes. There is a significant positive effect for hypertension and teenage morbidity, pointing to certain changes in the treated rayons that have occurred at the same time with the Project and had health deteriorating effects. This means that the current MIHP impact estimates actually underestimate the true impact.

Since sometimes the onset of the diabetes and hypertension may be related to pregnancies, a triple difference estimation has been performed following the specification in Equation (2). As the DDD results show, a significant negative impact of the MIHP participation is observed for the onset of the hypertension. Unfortunately, the data does not allow to use the same methodology for the teenage morbidity.

7 Conclusion

Exploiting a unique opportunity provided by the Mother and Infant Health Project in Ukraine this paper evaluates the impact of the improvement in

[6]The same estimation procedure has been applied to a sample restricted to metropolitan areas. This procedure allows checking the robustness of the average treatment effect estimates as smaller cities included in the main sample may be more heterogeneous in terms of the health outcomes and socio-economic background. As the estimation results reveal there is almost no difference in the qualitative results, but the point estimates are much larger in magnitude.

the quality of prenatal care and labor and delivery services on maternal and infant mortality and morbidity. This has become possible for two reasons. First is that the maternal and infant health outcomes are lagging behind those in Europe, thus allowing the identification of the effect of health-related interventions. Second, and the most important, is that the antenatal care and labor and delivery services are universally available in Ukraine. So, the estimation of the effect of the MIHP can be interpreted as an impact of the improvement in the quality of services, which is a rare opportunity in the research.

Employing program evaluation methods we find that the urban administrative units (rayons) participating in the Project have exhibited greater improvement in both maternal and infant health compared to the control rayons. At the same time no effect has been found on the pregnancy unrelated outcomes, such as diabetes, hepatitis, and teenage morbidity, indicating the causality of the MIHP impact. The MIHP impact is most pronounced for infant mortality and morbidity resulting from deviations in perinatal period and congenital anomalies and maternal mortality and morbidity related to late toxicosis, anemia, veins, and blood circulation system complications. The analysis suggests that the effect stems from the early attendance of antenatal clinics, lower share of C-sections, and greater share of normal deliveries.

Decomposition of the MIHP impact over time supported the causality of the main finding, since no effect has been found in the pre-Project period. At the same for such outcomes, as anemia, share of C-sections and normal deliveries, and most of the infant health outcomes, the Project impact depends on time: it is small in the first year and but increases in the second year. Lack of the impact in the third year for almost all outcomes can be explained by the limit on possible improvement.

Interestingly, the MIHP implied very little monetary intervention - all of the provided equipment has been low cost, but most of the change has occurred through trainings of the personnel and changes in their attitudes and practices. The maternities participating in the Project have become more mothers' and family friendly, practicing active partner participation in the process of labor and delivery, less involvement of medicines, and joint mother-baby accommodation. As a result, even after controlling for the overall trend in the country and oblast-specific time trend, the rayons with the MIHP-participating maternities do observe better maternal and infant health outcomes. And the impact is more significant statistically and economically for the outcomes directly related to the quality of antenatal care and labor and delivery services: decrease in infant morbidity and mortality due to deviations in the perinatal period and congenital anomalies, maternal mortality and various complications experienced by mothers during pregnancy, labor and delivery and in postpartum period.

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Table 1: List of Analyzed Health Outcomes

Maternal Health Outcomes	**Infant Health Outcomes**
Normal Deliveries per 100 deliveries	Stillbirths per 1,000 Newborns
C-sections per 100 deliveries	Infant Mortality per 1,000 Livebirths
Maternal Mortality per 100,000 livebirths	including those related to:
Per Cent of Pregnant Visited Antenatal Clinics before 12 weeks	Congenital Anomalies
Late Toxicosis per 100 Pregnancies	Perinatal Deviations
Deliveries Complications per 1,000 deliveries	Total Infant Morbidity per 100 Infants
includig those related to:	including those related to:
Urinary-Genital System	Congenital Anomalies
Anemia	Perinatal Deviations
Blood Circulation	
Veins Complications	
Thyroid Gland Complications	
Pregnancy and MIHP -unrelated Health Outcomes	
Tuberculosis Diagnosed per year per 1,000 Population	
Diabetis Diagnosed per 1,000 Population	
Hypertension per 100,000 adults	
Teenage Morbidity per 1,000 teenagers	

Table 2: Descriptive Statistics: Maternal Health and Infant Health Outcomes

	MIHP		Non-MIHP	
	2000	2006	2000	2006
Maternal Health				
Maternal Mortality	24.21	4.84	34.50	13.12
	(26.31)	(10.71)	(95.27)	(55.24)
Normal Deliveries	27.88	59.56	36.64	55.70
	(12.35)	(15.23)	(15.93)	(14.69)
C-sections	12.49	14.27	7.65	10.97
	(5.96)	(3.62)	(4.00)	(4.44)
Early Neonatal Visits	81.51	89.89	80.76	89.13
	(10.10)	(8.35)	(9.08)	(6.45)
Late Toxicosis	12.24	7.38	8.55	7.00
	(5.23)	(3.14)	(5.43)	(4.33)
Complicated Deliveries by Cause:				
Urinary-Genital System	8.25	8.40	7.16	7.34
	(4.61)	(5.73)	(8.12)	(6.91)
Anemia	25.31	12.42	28.48	24.24
	(14.60)	(5.07)	(18.83)	(21.13)
Blood Circulation	4.20	2.86	5.28	3.76
	(4.39)	(3.05)	(8.62)	(5.00)
Veins	2.90	1.83	2.04	2.00
	(1.97)	(1.25)	(2.28)	(1.92)
Thyroid Gland	17.22	10.08	8.86	8.84
	(25.26)	(9.39)	(12.46)	(11.85)
Infant Health				
Stillbirths	6.69	5.21	4.16	4.84
	(4.11)	(2.81)	(3.30)	(3.59)
Infant Mortality Total	13.75	9.18	11.14	10.45
	(4.47)	(3.76)	(5.76)	(5.49)
By Cause:				
Congenital Anomalies	39.70	26.02	31.57	25.09
	(12.38)	(13.89)	(34.65)	(25.58)
Perinatal Deviations	53.54	40.26	28.91	37.95
	(38.20)	(27.17)	(32.70)	(33.68)
Infant Morbidity Total	242.10	228.59	200.60	174.93
	(88.37)	(100.15)	(69.41)	(63.62)
By Cause:				
Congenital Anomalies	0.70	0.54	0.47	0.39
	(0.53)	(0.29)	(0.40)	(0.27)
Perinatal Deviations	3.65	1.81	3.23	2.30
	(1.75)	(1.51)	(2.06)	(1.37)
Observations	12	13	194	227

Notes: Standard errors in parenthesis.

Table 3: Estimated Impact of the MIHP

	MIHP	Other Programs	MIHP rayon	MIHP oblast	Other Programs
	(1)	(2)	(3)	(4)	(5)
Maternal Health					
Maternal Mortality	-7.10	-0.60	-63.06*	-58.45*	-2.11
	(9.24)	(16.95)	(34.02)	(33.73)	(17.08)
Normal Deliveries	10.12***	0.04	18.79***	9.06**	0.28
	(2.06)	(3.73)	(4.79)	(4.15)	(3.69)
C-sections	-2.48***	0.75	-4.85***	-2.48	0.69
	(0.70)	(1.07)	(1.75)	(1.56)	(1.05)
Early Neonatal Visits	2.09**	-0.11	2.89*	0.83	-0.08
	(0.85)	(1.08)	(1.58)	(1.54)	(1.08)
Late Toxicosis	-1.92**	-1.73	-2.87**	-1.00	-1.76
	(0.80)	(1.37)	(1.19)	(1.10)	(1.37)
Complicated Deliveries by Cause:					
Urinary-Genital System	-1.82	-0.44	-4.38**	-2.67	-0.51
	(2.01)	(1.41)	(2.02)	(1.95)	(1.44)
Anemia	-5.02***	-5.05**	-11.27***	-6.53*	-5.22**
	(1.86)	(2.54)	(3.69)	(3.62)	(2.54)
Blood Circulation	-1.39**	-0.45	-2.19*	-0.84	-0.47
	(0.57)	(0.72)	(1.17)	(1.04)	(0.71)
Veins	-0.54**	-0.26	-0.60	-0.06	-0.26
	(0.24)	(0.33)	(0.76)	(0.75)	(0.33)
Thyroid Gland	-0.96	-0.60	-4.34	-3.53	-0.69
	(1.41)	(1.66)	(4.84)	(4.80)	(1.66)
Infant Health					
Stillbirths	-1.58***	-0.20	-1.01	0.59	-0.18
	(0.54)	(0.67)	(1.61)	(1.61)	(0.67)
Infant Mortality Total	-3.13***	-2.12	-2.99	0.15	-2.12
	(0.90)	(1.55)	(2.48)	(2.55)	(1.56)
By Cause:					
Congenital Anomalies	-8.12*	-0.46	-21.15	-13.60	-0.81
	(4.27)	(6.12)	(19.89)	(20.05)	(6.11)
Perinatal Deviations	-14.10***	-9.62	-20.64**	-6.83	-9.80
	(5.22)	(8.63)	(9.53)	(9.49)	(8.65)
Infant Morbidity Total	-1.71	-0.46	-35.57	-35.36	-1.37
	(8.57)	(11.74)	(43.54)	(43.47)	(11.77)
By Cause:					
Congenital Anomalies	-0.03	-0.10	-0.10	-0.07	-0.10
	(0.04)	(0.11)	(0.08)	(0.08)	(0.11)
Perinatal Deviations	-0.53**	0.53	0.06	0.61	0.55
	(0.21)	(0.43)	(0.45)	(0.45)	(0.43)
Observations	1612		1612		
Number of Rayons	244		244		

Notes: Standard errors in parenthesis.

Table 4: Estimated Impact of the MIHP: Time Dimension

	Before			After			Other
	3 years	2 years	1 year	1st year	2nd year	3d year	Programs
Outcomes							
	(1)	(2)	(3)	(4)	(5)	(6)	
Maternal Mortality	-16.52	9.23	21.54	4.25	-17.12	-4.78	0.95
	(18.22)	(14.37)	(14.43)	(11.91)	(14.72)	(16.79)	(16.62)
Normal Deliveries	-0.62	-1.73	0.63	10.03***	12.30***	4.23	0.16
	(2.61)	(2.38)	(2.85)	(3.40)	(3.23)	(3.08)	(3.71)
C-sections	0.76	0.91	-0.48	-1.94**	-2.68**	-2.06	0.78
	(1.06)	(0.85)	(0.76)	(0.97)	(1.20)	(1.74)	(1.08)
Early Neonatal Visits	-0.90	-0.22	-0.60	2.70**	1.22	-0.34	0.10
	(0.88)	(1.09)	(0.93)	(1.24)	(1.25)	(1.51)	(1.08)
Late Toxicosis	-1.23	-1.51	-1.80	-2.58**	-3.19**	-3.68	-1.61
	(1.21)	(1.30)	(1.11)	(1.20)	(1.56)	(2.35)	(1.41)
Complicated Deliveries by cause:							
Urinary-Genital System	2.31	1.25	1.60	0.64	-1.62	-2.56	-0.26
	(2.67)	(1.58)	(1.51)	(1.42)	(3.09)	(5.43)	(1.59)
Anemia	-7.25	-7.13	-8.39	-8.73*	-11.65***	-12.13**	-4.53*
	(4.69)	(4.54)	(5.33)	(4.63)	(4.04)	(4.80)	(2.62)
Blood Circulation	-0.09	0.78	-1.16*	-1.37*	-1.68	-1.46	-0.44
	(0.95)	(1.10)	(0.68)	(0.75)	(1.06)	(1.06)	(0.71)
Veins	0.14	-0.06	-0.12	-0.09	-0.91*	-1.22**	-0.18
	(0.39)	(0.32)	(0.34)	(0.36)	(0.49)	(0.58)	(0.31)
Thyroid Gland	-3.74*	-0.86	-0.46	-0.14	-5.24*	-2.44	-0.17
	(2.22)	(1.76)	(1.72)	(1.92)	(3.13)	(2.78)	(1.87)
Observations	1612						
Number of Rayons	244						

Table 5: Estimated Impact of the MIHP: Time Dimension (cont.)

	Before			After			Other
Outcomes	3 years	2 years	1 year	1st year	2nd year	3d year	Programs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Stillbirths	-0.08	0.04	-0.48	-1.47**	-2.09**	-1.66	-0.15
	(0.81)	(0.87)	(0.76)	(0.72)	(0.86)	(1.23)	(0.67)
Infant Mortality Total	0.69	-1.89*	-1.98	-3.02**	-5.53***	-3.30*	-1.95
	(1.11)	(1.03)	(1.23)	(1.34)	(1.34)	(1.91)	(1.51)
By Cause:							
Congenital Anomalies	5.74	-2.45	-0.33	-7.01	-11.32**	-1.81	-0.47
	(6.95)	(5.83)	(6.35)	(5.63)	(5.62)	(7.42)	(5.65)
Perinatal Deviations	-1.04	-7.35	-9.24	-18.02**	-20.03**	-15.00	-9.48
	(6.32)	(5.60)	(5.64)	(7.47)	(8.82)	(10.81)	(8.23)
Infant Morbidity Total	-5.36	5.62	0.32	4.28	-4.47	-13.26	0.66
	(13.27)	(10.55)	(11.76)	(14.33)	(15.64)	(13.74)	(11.98)
By Cause:							
Congenital Anomalies	0.01	0.07	0.05	0.01	-0.02	0.00	-0.10
	(0.09)	(0.08)	(0.09)	(0.09)	(0.08)	(0.09)	(0.11)
Perinatal Deviations	-0.07	-0.37	-0.65***	-0.85***	-0.69**	-0.70*	0.53
	(0.26)	(0.26)	(0.25)	(0.31)	(0.32)	(0.39)	(0.42)
Observations	1612						
Number of Rayons	244						

Table 6: Estimated Impact of the MIHP on Placebo Outcomes

			Mean (standard deviation)			
	MIHP		MIHP		non-MIHP	
	DD	DDD	2000	2006	2000	2006
Tuberculosis Morbidity	-5.45*	-0.97	58.44	76.27	60.73	81.40
	(2.83)	(0.67)	(12.80)	(23.43)	(19.39)	(28.54)
Diabetis Morbidity	3.56	0.35	112.00	202.37	121.17	215.62
	(7.02)	(1.51)	(30.27)	(37.51)	(60.88)	(65.90)
Hepatitis	7.55	-3.69	90.77	38.53	60.14	26.14
	(17.58)	(3.30)	(72.00)	(32.52)	(80.35)	(35.39)
Hypertension	0.50**	-0.11**	2.43	2.44	2.68	2.41
	(0.21)	(0.05)	(1.30)	(1.04)	(1.79)	(1.04)
Teenage Morbidity	2.43***		9.75	9.58	8.52	9.50
	(0.83)		(4.42)	(2.26)	(2.79)	(3.53)
Number of Rayons	244	243				
Observations	1612	1497				