Causal effect of health on labor market outcomes: Evidence from a random-assignment iron supplementation intervention

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There is abundant evidence that health status and labor market success are positively correlated. Isolating the component of this correlation that can be attributed to a causal effect of health on labor outcomes has proved to be very difficult. This paper provides new evidence on the issue. Pinning down the extent to which the effect is causal is extremely important. For example, if improvements in health result in higher productivity at work and thus elevated economic growth, a case may exist for greater investment in the provision of health services and information about health.

This paper focusses on the effect of iron deficiency on labor market success. Iron deficiency is widespread throughout the developing world. Poor people are far more likely to suffer from iron deficiency than those who are better off. Moreover, rigorous random assignment studies conducted with adult subjects have shown that iron deficiency results in reduced work capacity and energy efficiency which suggests that part of the link between health and socio-economic disparities may be explained by the causal effect of health on economic prosperity.

Data are drawn from a random assignment treatment-control design experiment we are conducting in Indonesia. The Work and Iron Status Evaluation (WISE) is an on-going study following over 10,000 adults living in 5,000 households in Purworejo district in Central Java. Half the respondents were assigned to a treatment of 100 mg of iron every week for a year; the controls were given a placebo. Treatments were also given deworming tablets. Compliance was monitored carefully and blood iron levels were measured before, during and after the intervention study.

Contrasting a series of labor market outcomes prior to the iron intervention with the same indicators after 12 months of supplementation, we are able to measure the effect of iron supplementation on the treatments. These changes are compared with changes among controls to measure the causal effect of iron on the study participants. The biomedical literature has shown that iron supplementation among iron replete adults does not affect iron status and, therefore, should have no effect on economic success. We thus compare changes in indicators of subjects who were iron deficient prior to supplementation with similar subjects who were not iron deficient. This provides a second measure of the impact of the iron supplementation.

We focus on changes in labor force participation, hours of work and hourly earnings. We also contrast the type of work that subjects were engaged in prior to the intervention with work after the intervention. Most of the study participants are engaged in agriculture; we examine the crops raised, the amount of hired and exchange labor, type of technology used in agriculture and self-reported indicators of hours spent on strenuous tasks.

In an effort to identify some of the pathways through which elevated iron in the blood may affect economic success, we also examine changes in physical health, psycho-social health and time allocation. Self reported indicators of general health status provide an overall assessment of well-being. The literature suggests that supplementation of iron deficient subjects should be associated with increased energy to complete tasks, take on new tasks and engage in new activities. We explore changes in these indicators. In addition, we examine whether subjects' attitudes towards challenges, their satisfaction with their accomplishments and their aspirations for the future are affected by iron supplementation.

Finally, to better understand the dynamics underlying household decisions, we model the joint effects of changes in health of husbands and wives on changes in their own and their spouses labor market indicators. These models exploit the fact that among many couples in the study, one was iron deficient at baseline and the other was iron replete.

The random assignment design permits isolating the magnitude of the causal effect of iron on the economic lives of the respondents and their families. Prior to measuring those effects, it is necessary to determine whether blood iron levels responded to the treatment. Blood was drawn from every respondent (over the age of 1) with a pin prick to the finger prior to the intervention and hemoglobin (Hb) levels were measured at that time with an in-home Hemocue meter carried by the interviewer. Hb levels were measured every four months thereafter at the time of each follow-up interview. Among adult males, treatments with Hb below 12g/dl prior to the intervention had increased levels after 4 months and further increases after 8 months of treatment. There were small increases between 8 and 12 months of treatment suggesting that these males had reached saturation after 8 months of treatment. Among adult females, Hb responded to treatment among those with lower levels of baseline Hb (<11g/dl) and the rate of response was slower than among males. These differences between males and females are suggested by the literature on iron absorption and are a reflection of the biology of iron absorption. Hb is a measure of current iron status. We have also measured levels transferrin receptors (TfR) which indicate iron stores and which should respond more slowly to the treatment than Hb. After the intervention, iron stores are significantly higher among treatments relative to controls. We conclude that iron levels have been elevated among treatments, relative to controls. We turn next to the evidence on the impact of the intervention on economic prosperity.

Preliminary results suggest that hourly earnings rose substantially and significantly among iron deficient males who received the treatment (relative to controls and relative to iron replete males). Effects for females are significant but smaller in magnitude. After twelve months, there is little evidence of changes in hours of work or type of work among those who were working at the time of the baseline. About half the men were working in the market wage sector and about half

were self-employed prior to the intervention. If iron supplementation results in elevated productivity, we would expect hourly earnings of the self-employed to respond more quickly than hourly wages. The evidence is consistent with this expectation. The increase in hourly earnings of males is almost entirely concentrated among those who were self-employed at baseline. Iron deficiency is most common among older workers; while there is no evidence that their earnings have responded to the intervention, older males and females who were iron deficient at baseline are significantly more likely to be working a year later if they received the supplement.

We have examined several pathways through which these effects might have occurred. Iron deficient adult males who received the treatment report increased levels of activity and energy. After 12 months of treatment, relative to their responses to the same questions at baseline, they spent significantly less time sleeping (based on a 24 hour time recall) with almost all that time taken up in additional leisure, they were less likely to lose work time to illness, there were able to conduct physically arduous activities and they were less likely to feel fatigued and unable to complete tasks they started. There are, however, no differences in perceptions of own general health status indicating that these sorts of general health indicators lack the specificity to capture the kinds of changes that are observed in biomarkers and targeted questions.

On-going research examines an array of choices about work including choice of technology in agriculture, crop choice and demand for non-family labor. We also examine interactions among family members and model the effect of changes in health of one member when the health of other members is not affected by the treatment (because that member was iron replete prior to the intervention).

Our preliminary results provide evidence in support of the hypothesis that health has a causal effect on economic prosperity of males, and to a less extent females, during middle and older ages. It is also clear that this causal mechanism explains only a small part of the correlation between health and economic success.