Can future design improve indoor air quality in rural households of Bangladesh?

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Introduction

Burning of solid fuels such as firewood, crop waste, and livestock dung for cooking and heating causes indoor air pollution, especially in poor households, which leads to respiratory illnesses and premature death. However, little is known about what triggers households to persistently improve indoor air quality. Figure 1 shows the overall indoor air pollution condition during cooking inside households.

Figure 1: Indoor cooking and air pollution

Methods

This research considers a future design (FD) approach for the possible trigger where people are asked to think of a problem and take actions through taking a perspective of future generations. We investigate the question "how does the FD approach impact on the indoor air quality (IAQ)?" and the hypothesis "FD induces people to make a persistent improvement to IAQ." We employ a double-round experiment with two treatments of baseline, and FD, collecting IAQ information on air pollution level, $PM_{2.5}$, PM_1 and PM_{10} at home and kitchen with 200 households in Bangladesh over 135 days. In baseline, households' report the IAQ information. In FD, they additionally think a vision, a mission and a strategy for the IAQ. They take each perspective of past, current and future generations and then deliberate to think of the same issue.

Data

We conducted social experiments in Bangladesh to collect the indoor air pollution information. The households were selected by following the stratified random sampling techniques. Questionnaire surveys and social experiments were conducted with the households to collect necessary information regarding their socio-demographic variables and indoor air pollution conditions.

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Results

To estimate the average treatment effects on the treated (ATT), we apply a difference-in-difference (DID) method with multiple time periods. The result indicates that FD affects people to have a sustained decrease in air pollution level, $PM_{2.5}$, PM_1 and PM_{10} at home and kitchen as compared to baseline treatment.

Table 1 exhibits the difference-in-difference (DID) estimates, i.e., average treatment effects on the treated (ATT) indicating the impact of FD on both air pollution at home and kitchen. It is apparent that DID estimates for air pollution show consistently positive and statistically significant results at a 5% level.

Difference-in-difference (DID) models	Average Treatment Effects on air pollution level at home	Average Treatment Effects on air pollution level at kitchen	N
Baseline vs. Future Design	-11.90^{**}	-9.61^{**}	600

Table 1: Average treatment effect on air pollution level

Table 2 exhibits the difference-in-difference (DID) estimates, i.e., average treatment effects on the treated (ATT) indicating the impact of FD on both PM 2.5 at home and kitchen. It is apparent that DID estimates for PM 2.5 show consistently positive and statistically significant results at a 1% and 5% level.

Difference-in-difference (DID) models	Average Treatment Effects on PM 2.5 level at home	Average Treatment Effects on PM 2.5 level at kitchen	N
Baseline vs. Future Design	-52.73^{***}	-89.80^{**}	600

Table 2: Average treatment effect on PM 2.5 level

Table 3 exhibits the difference-in-difference (DID) estimates, i.e., average treatment effects on the treated (ATT) indicating the impact of FD on both PM 1 at home and kitchen. It is apparent that DID estimates for PM 1 show consistently positive and statistically significant results at a 5% and 10% level.

Difference-in-difference (DID) models	Average Treatment Effects on PM 1 level at home	Average Treatment Effects on PM 1 level at kitchen	N
Baseline vs. Future Design	-37.70^{**}	-62.45^{*}	600

Table 3: Average treatment effect on PM 1 level

Table 4 exhibits the difference-in-difference (DID) estimates, i.e., average treatment effects on the treated (ATT) indicating the impact of FD on both PM 10 at home and kitchen. It is apparent that DID estimates for PM 10 show consistently positive and statistically significant results at a 1% and 5% level.

Difference-in-difference (DID) models	Average Treatment Effects on PM 10 level at home	Average Treatment Effects on PM 10 level at kitchen	N
Baseline vs. Future Design	-64.32^{***}	-95.22^{**}	600

Table 4: Average treatment effect on PM 10

Conclusion

The novel aspects of this study is to consider the perspective taking of future generations for analyzing households indoor air pollution reduction by conducting multiple rounds of social experiments. Overall, FD demonstrates a great potential for inducing people to make a persistent improvement to IAQ.