donor disappears during puberty and remains only manifest during the early years after the transplantation. At that time, the glomerular filtration rate of the living-related graft is significantly better than that of cadaveric grafts. Moreover, Pape and colleagues did not take into account mid-parental height, and for a small study group it is possible that by chance the mid-parental height is higher in the living-related group and therefore will achieve a better final height.

Paediatric nephrologists are defending a “young for young” allocation programme in which children should have absolute priority when children’s organs are available, because the young kidney can grow with the child and maintain a better glomerular filtration rate. Pape and colleagues do show that benefits other than glomerular filtration rate are of major interest for a paediatric transplant recipient: they clearly show that the glomerular filtration rate of the living-related transplanted kidney is not worse than that of the average cadaveric graft, 5 years after the transplantation.

Pape and colleagues speculate that in kidneys from cadaveric donors the dying and prolonged ischaemia time in cadaveric grafts result in changed cytokine production that alters bone metabolism mainly during puberty: this speculation is attractive. Brain death initiates a cascade of molecular events which include the release of proinflammatory mediators, leading to cellular infiltrates that contribute to reduced graft survival.[11] But Pape did not measure cytokines, and gene expression of cytokines affecting bone metabolism needs more investigation before firm conclusions can be drawn.

Pape and colleagues’ results open a new debate on growth in children after renal transplantation and on the benefit of living-related donation. However, we need confirmation of this challenging finding from larger databases, such as the North American Pediatric Renal Transplant Cooperative Study, before the use of living-related donation in children with chronic renal failure can be the preferred option.

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Indoor air pollution and health in developing countries

Biomass fuels and coal are vital to health and welfare in developing nations.[1] Worldwide, almost 3 billion people use biomass—wood, charcoal, crop residues, and animal dung—and coal as their main source of energy for cooking, heating, and other household needs (eg, food preservation).[2] Combustion of biomass and coal emits mixtures of pollutants that have been associated, with varying degrees of evidence, as a cause of acute respiratory infections, chronic obstructive pulmonary disease, lung cancer (for coal smoke), asthma, nasopharyngeal and laryngeal cancers, tuberculosis, and diseases of the eye.[2] Emissions are particularly high when solid fuels are used in open or poorly ventilated stoves, typical of most developing nations.

Estimates of exposure and risk for acute respiratory infections, chronic obstructive pulmonary disease, and lung cancer, on which there are several epidemiological studies, show that over 1·6 million premature deaths, and nearly 3% of the global burden of disease, were attributable to indoor air pollution from solid fuels in

Figure: **Biomass (wood, charcoal, crop residues, animal dung) and coal are common sources of energy in many developing countries**
Traditional open (three-stone) fire (left) is even used for analogies in political messages (middle). Wood is often collected by women (right). Women and small children also have largest exposure to indoor air pollution from cooking (left); exposure from heating may be similar in men and women.

2000.[2] Two subsequent studies found an association between exposure to indoor air pollution during pregnancy and low birthweight: Boy et al[3] in 2002 and, more recently, Vinod Mishra and colleagues.[4] Using a retrospective analysis of data from the Demographic and Health Survey in Zimbabwe, Mishra et al[4] found that babies born to mothers cooking with wood, dung, or straw were, on average, 175 g lighter (95% CI −300 to −50 g) than those born to mothers using liquid petroleum gas, natural gas, or electricity. If this association is confirmed as causal, and its health effects on the population are quantified, the disease burden attributable to indoor air pollution would substantially increase, because low birthweight has significant consequences for the health of children and adults. This association also implies that the hazards of indoor air pollution probably occur from a continuum of exposures: pregnancy followed by childhood and adulthood.

The large disease burden, and its concentration in women and children in poor households, have helped identify indoor air pollution from solid fuels as a major concern in global health. The growing determination to reduce the health hazards of solid fuels might soon parallel those surrounding water and sanitation in the last quarter of the 20th century. For example, solid-fuel use is an indicator for Goal 7 (environmental sustainability) of the Millennium Development Goals, and is related to at least two other goals (reducing child mortality and promoting gender equality).

Exposure to indoor air pollution is tightly linked with household access to, and choice of, energy technology—ie, fuel-stove combinations—and energy-related behaviours. Therefore, whilst health constitutes the largest consequence of solid-fuel use, large-scale intervention programmes will require links to many other sectors, such as energy, rural development, and finance.[1] Complete transitions to electricity or petroleum-based fuels, such as natural gas and kerosene, will certainly provide substantial health gains.[5,6] (Although kerosene has several hazards, such as increased risk of poisoning or burns, these hazards have not been quantified systematically, and are probably smaller than the benefits of kerosene from reducing pollution.) The transition to cleaner fuels has already taken place in wealthier households in many developing nations, especially in urban areas. Higher income, however, does not automatically create a parallel shift to commercial energy for household needs. For example, in China, where rapid economic growth and infrastructure expansion have contributed to near-universal access to electricity,[7] nearly 80% of households continue to use coal or biomass as their main fuel for cooking and heating.[2] Obstacles to fuel transition include high capital costs for the infrastructure needed to generate, process, and deliver clean energy, and the volatility of petroleum-based fuel prices and supplies, both internationally and as a consequence of national energy policies (see table 3 in Ezzati et al[1]). Therefore, for many low-income nations and households, transition to clean fuels is not a realistic option in the next two to three decades.

These obstacles point to two important research directions for effective interventions. First, we need ambitious research and development on alternative technologies for accessible and clean energy sources, and on the economic and regulatory institutions required for large-scale dissemination of these technologies.[1] Second, we need interventions that lower emissions by modifying specific aspects of current fuel-stove combinations and energy-use behaviours. (Housing change—eg, separate kitchen or additional windows—can also reduce exposure; reductions are likely to be smaller for those who cook and remain close to their fires.) Such interventions will almost certainly have to be designed for specific local conditions, because of variations in the natural environment and climate, the purposes of energy use (eg, cooking *vs* heating), local infrastructure, user behaviours, and sociocultural circumstances. Current options include preprocessing biomass or coal to burn more cleanly—eg, charcoal in parts of sub-Saharan Africa[6] and biogas in parts of Asia—and stoves with better ventilation. Although there was a great deal of initial excitement around the so-called improved stoves,[8] more systematic evaluations have shown barriers to stove adoption, and highly variable performance caused by technical complexities of stove design, lack of maintenance, and users' behaviour, which modify ideal combustion.[9,10] These barriers and complexities must be taken into account in future research.

Several health-research topics are also important for more effective or less costly interventions. First, many interventions for indoor air pollution partly reduce exposure. Evaluating the effectiveness of these interventions requires quantifying hazard along a continuum of exposures, very rare in current research.[11] Analysis of continuous exposure-response relations in turn requires technologies and methods for exposure measurement that can be used in community studies. Second, we need to establish the temporal dimensions of exposure and hazard. Specific questions include the effects of exposure during pregnancy, at a young age, and as adults on hazards of various disease outcomes, and reversibility of risk after exposure reduction. Third, because the health outcomes caused by indoor air pollution also have other common risk factors—eg, childhood and maternal undernutrition for low birth-weight and acute respiratory infections, and smoking for chronic obstructive pulmonary disease and lung cancer—the hazards of multiple exposures and benefits of individual and combined interventions must be studied.

In the past few decades, individual and institutional efforts have established indoor air pollution as an important global-health risk, especially affecting the poor. This increased awareness must be sustained. The crucial contribution of future research in alleviating the burden of disease associated with the use of solid fuel, however, lies less in evidence-based advocacy, and more in strengthening the scientific basis of technological innovation and technology management to reduce the large and inequitable burden.

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