Stay Home, Stay Healthy? That Depends on the Home

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People spend 90 percent of their time indoors (Klepeis et al., 2001). We are working in office buildings, living in homes, and spend leisure time in shopping malls, restaurants, the gym, etc. However, the lock-down measures currently implemented in most countries around the world are forcing us to spend our time at just a single place – our own home. Indeed, the mantra across many U.S. states has become "Stay Home, Stay Healthy."

Beyond the direct effects of COVID19 on human health, there is no shortage of news headlines on the indirect implications that the COVID19 pandemic may have on physical and mental health, including the negative effects of reduced exercise, increased mental and psychological stress, and delayed medical procedures. Another important, but overlooked public health issue is the fact that individuals now face prolonged exposed to the indoor quality of their own home and the possible negative health consequences of that exposure. The big question: is staying home is actually "staying healthy"? Well, that depends. Our research finds that the maintenance status of a home has a significant impact on both the objective and subjective health of individuals, with increased doctor visits and decreased mental health status in homes with deficient maintenance. Given that nationally, 35.8 percent of occupied housing units needed at least one repair (Philadelphia Fed, 2019), staying home isn't thus all that healthy for a large part of the population. In addition, early estimates indicate that the unfolding economic crisis is limiting households' remodeling activities, so we expect to see further increases in the likelihood of exposure to inadequate housing conditions (JCHS, 2020).

[0] This summary article is based on the paper "The Impact of Housing Condi- tions on Health Outcomes," forthcoming in Real Estate Economics. Link to full paper here

Housing and health

A home protects against the external climate, such as heat and pollution, but equally offers and indoor climate – this climate can influence our health. That was perhaps more evident in the past than it is now. The moldy basements and drafty attics that so often appear in the books of Dickens had significant real-life implications for the spread of disease, affecting physical and mental health, and increasing mortality (Rosen, 2015). Slum clearance, sanitation and provision of affordable housing are just some examples of public health policies enacted in (recent) history to ensure healthy living conditions. These measures helped to significantly increase average life expectancy in our modern-day society (Shaw, 2004).

Now that the excessive cases of bad housing quality have mostly been resolved, at least in developed economies, the topic of housing quality is no longer as frequently addressed by researchers. The limited number of existing studies on the topic of housing conditions and health outcomes are mainly based on small-scale intervention studies, mostly fail to establish causality, or address housing conditions in poor areas, often in slums or developing countries, making the results hard to generalize to developed economies (see, for example, Barron and Torero). Even though housing quality has improved in most developed countries, maintenance conditions remain subpar for 10-15 percent of the Dutch and German building stock. A recent survey organized by the Joint Center for Housing Studies of Harvard University estimates that 29 percent of U.S. homeowners and 35 percent of renters expressed concerns over some aspects of their homes and their implication for occupant health (Jeunesse, 2019).

Perhaps as a response to concerns about housing quality, U.S. households undertake substantial investments in home maintenance, spending more than $400 billion a year on home renovations and repairs. A large fraction of such investments involve improvements on windows, HVAC systems, and insulation. Beyond leading to enhanced energy efficiency, these investments may also enhance the indoor environmental quality of the home. The big question is whether those enhancements have implications for the health outcomes of tenants and homeowners.

Research design

A large fraction of such investments involve improvements on windows, HVAC systems, and insulation. Beyond leading to enhanced energy efficiency, these investments may also enhance the indoor environmental quality of the home. The big question is whether those enhancements have implications for the health outcomes of tenants and homeowners.

We use a long-running household panel dataset, the German Socioeconomic Panel (GSOEP) (Wagner et al., 2007), to identify a causal link between housing conditions and health outcomes. Each participant is interviewed, individually, and asked to evaluate the condition of their dwelling, as well as to complete an extensive questionnaire on subjective health status and on their demand for healthcare, objectively measured by the number of visits to a doctor and the days of sick leave. In addition, the GSOEP dataset provides ample data on age, income, and lifestyle choices (e.g. smoking, drinking, BMI, etc.). The sample includes more than 300,000 respondent/year observations for the period between 1992 and 2014, allowing for monitoring of the health outcomes of the same individual, exposed to varying housing conditions, over the sample period. The sample is equally divided between tenants and homeowners, a feature of the German housing market, which has a well-developed rental market that is used by people from all walks of life.

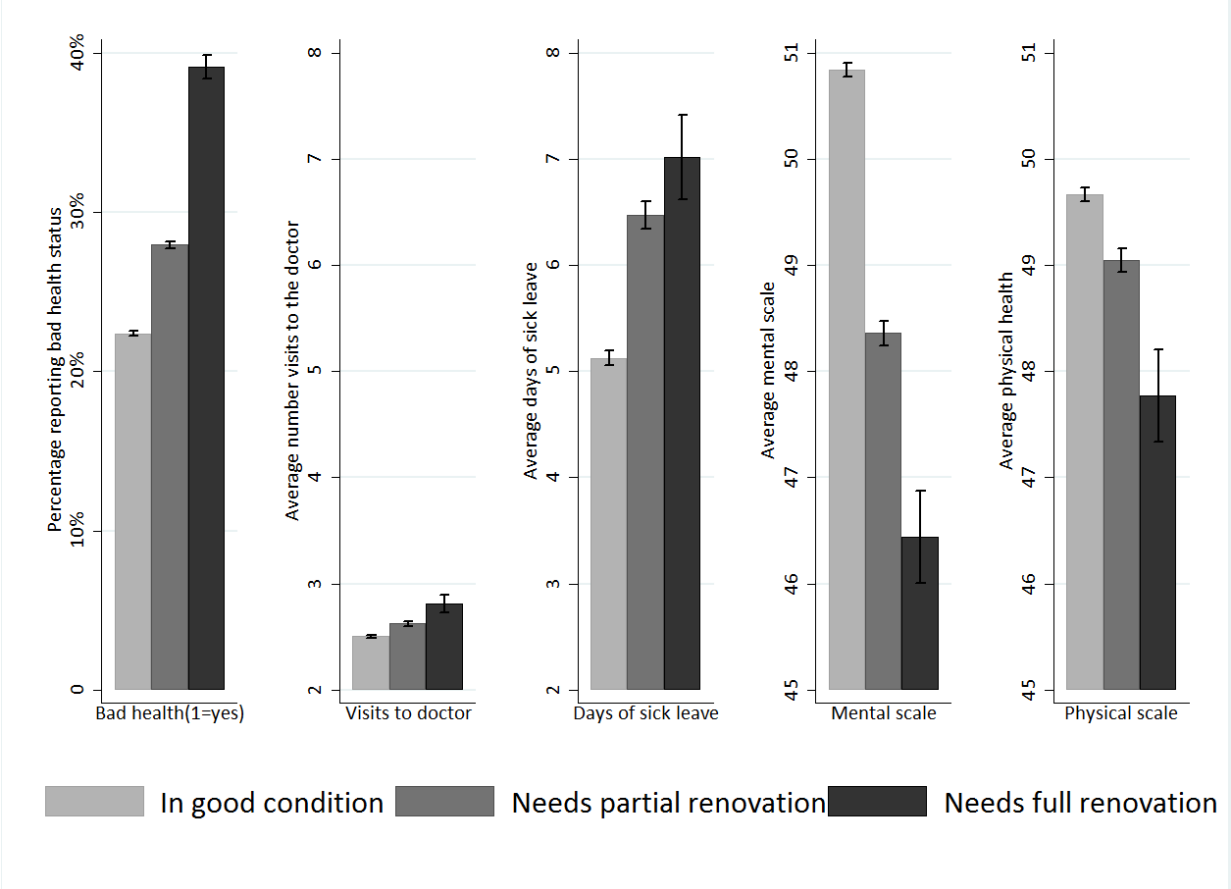
Results

Descriptive Analysis

To begin with, we compare average health outcomes on five different dimensions with varying degrees of housing quality. Those five health dimensions are: the percentage of respondents reporting bad health, the number of doctor visits in the last three months, the number of days of absenteeism in the last three months, and the average mental and physical health on a scale from zero to 100. The GSOEP distinguishes three levels of home maintenance: home in good condition, home in need of limited renovation, home in need of complete renovation. As the need for renovation becomes more urgent, things like drafts, moisture, mold and poor insulation become more common and this has direct consequences for the indoor climate in the home.

Figure 1 shows that respondents score worse in every aspect of health as their home maintenance status deteriorates. Not only are reports of poor mental and physical health, but there are also clear indications of the economic costs this entails in terms of seizure of the medical system (doctor's visit) and lower productivity (absenteeism). Respondents in good homes go to the doctor 2.5 times and have five days of absenteeism, both measured every three months – that's three times and seven days, respectively, for people in a home that needs drastic renovation.

Figure 1
Housing conditions and occupant health



Notes: Figure 1 presents the average level of health measures for different housing conditions as well as the 95 percent confidence interval. Current health ranges from 1 (very good health) to 5 (bad health). The three measures are available for all years in our sample (1990-2014). Mental and physical scales range from 0 to 100 (available for survey waves 2002, 2004, 2006, 2008, 2010, 2012 and 2014).

Econometric Analysis

However, the simple summary statistics are not really convincing: the observed differ-

ences can be the result of things that affect both housing quality and health: for example, income is related to specific lifestyle choices such as smoking, exercise and nutrition (Frijters et al., 2005), but also to the quality of the home that one can afford. And older people are on average less healthy and put less energy into the maintenance of their home. In addition, home maintenance for homeowners is endogenous and healthier citizens may make better decisions in that regard.

So, in order to determine a possible causal relationship between housing quality and health, a better analysis is needed. We do not look at the health differences between different respondents, but at the development of the health of a given respondent (whereby we check for changes in age, income, lifestyle) with a deteriorating and subsequently improved state of maintenance of the home. We look at tenants separately, because for them the decision to renovate is made by the landlord and is therefore separate from the health of the residents.

We first analyze the impact of housing conditions on subjective measures of health – a "bad health" perception indicator, a mental health scale, and a physical health scale. The results from the empirical analysis (reported in Palacios, Kok, Eichholtz, and Aydin, in press) show that the effects of housing conditions on health outcomes are substantial. Based on all model specifications and all subjective health measures included in the analysis, exposure to homes that are anything less than well-maintained is related to deteriorated health outcomes.

We then focus on objective measures of health – doctor visits and sick leave. Column 1 of Table 1 shows that, at the intensive margin, those individuals living in dwellings with a poor indoor environment experience an 11 percent increase in demand for healthcare, as reflected in the number of visits to the doctor. The effects show substantial heterogeneity based on dwelling conditions, and hold across income groups and tenure choice (i.e. whether an individual owns or rents a home). Interestingly, we do not find a statistically significant relationship between poor housing conditions and days of sick leave from work.

Columns 2-6 of Table 1 show the marginal effect of housing conditions on doctor visits for five different age groups: respondents below 30 years old, 31 through 40, 41 through 50, 51 through 63, and those with an age of 64 and older. For the youngest group, we do

Table 1
Heterogeneous effects by age group

	(1) Doctor visits Full Sample	(2) Doctor visits Age 18-30	(3) Doctor Visits Age 31-40	(4) Doctor Visits Age 41-50	(5) Doctor Visits Age 51-63	(6) Doctor Visits Age > 64
Needs partial	0.060**	-0.123	0.043	0.018	0.146	0.240***
renovation (1=Yes)	[0.030]	[0.088]	[0.103]	[0.088]	[0.100]	[0.091]
Needs major	0.293***	0.102	0.524*	0.567*	0.468	0.766**
renovation (1=Yes)	[0.095]	[0.276]	[0.316]	[0.315]	[0.355]	[0.329]
Number of observations	272,130	27,533	34,838	36,887	41,911	46,594
Number of individuals	2.612	14,302	15,001	13,738	12,046	10,212
Mean dependent var.	62,281	1.863	2.051	2.247	3.111	3.830
Individual-fixed effects	YES	YES	YES	YES	YES	YES
Dwelling-fixed effects	YES	YES	YES	YES	YES	YES
Year-fixed effects	YES	YES	YES	YES	YES	YES

Notes: Coefficients from year fixed-effects and socio-demographic controls not reported due to space limitations (available upon request).
Heteroskedasticity-robust standard errors are in brackets. Standard errors are clustered at household level. *P<0.10. ** P<0.05. *** P<0.01

not find a significant relationship between housing conditions and health. However, for the 31-40 and 41-50 age groups, we find a marginally statistically significant (at 10 percent) effect on doctor visits when homes are in need of a major renovation: these respondents visit their doctor respectively 25 percent more often than people of the same age who reside in a home that is in good condition. The documented effect is strongest for citizens aged 64 and older: if their home needs a partial renovation, they visit the doctor 6 percent more often, increasing to 20 percent if the home needs a major renovation. In other words, our average results for the entire sample are mainly determined by the elderly. This may also explain the fact that in the regression analysis we no longer observe a connection between home maintenance and absenteeism: the effect could possibly be there for the elderly, but this group no longer works (at least, not typically).

Avoidance Behavior

The literature shows that individuals do not necessarily remain passive towards the hazards in their living environments. People tend to take multiple actions to avoid or reduce their exposure to health detrimental environmental conditions, such as moving away from hazards. We therefore study avoidance behavior of individuals as it relates to housing conditions: people can avoid or reduce their exposure to poor housing conditions by either moving or by renovating their home.

Table 2 shows how tenants and buyers deal with poor housing conditions. Columns 1 and 2 show the percentage of removals per year, from homes with moderate or poor maintenance, for tenants (column 1) and buyers (column 2). The results are very similar: the aversion to a poorly maintained home is apparently comparable for both groups of citizens. However, the results for renovations give a completely different picture. We see a renovation rate of 7 percent per year for owner-occupiers with a moderately maintained home. That is 23 percent for a poorly maintained home. For rental properties, these percentages are 3 and 5 percent respectively. Due to the lack of investment in rental properties, tenants therefore remain exposed to an unhealthy indoor climate of a house for much longer, with corresponding effects on their health. Homeowners themselves benefit from the health effect of a renovation, but that does not apply to landlords. For them it is an external effect, which weighs less in the investment decision.

Table 2
Avoidance behavior in response to deficient housing conditions

	(1)	(2)	(3)	(4)	(5)
	Move $_t$ (1=yes)		Renovation in Dwelling $_t$ (1=yes)		
	Tenant	Home-owner	Tenant (Self-Paid)	Tenant (Paid by Landlord)	Home-Owner
Needs partial renovation $_{t-1}$	0.010***	0.012***	0.008***	0.030***	0.074***
	[0.002]	[0.002]	[0.002]	[0.003]	[0.007]
Needs major renovation $_{t-1}$	0.034***	0.029***	0.005	0.047***	0.226***
	[0.005]	[0.009]	[0.005]	[0.008]	[0.026]
Observations	118,298	133,248	109,712	109,712	123,906
R-squared	0.033	0.013	0.004	0.005	0.010
Number of individuals	21,251	21,604	18,589	18,589	18,758
Mean dependent var.	0.0232	0.0232	0.039	0.144	0.199
Socio-demographic controls	YES	YES	YES	YES	YES
Year-fixed effects	YES	YES	YES	YES	YES
Individual-fixed effects	YES	YES	YES	YES	YES
Dwelling-fixed effects	NO	NO	YES	YES	YES

Notes: Coefficients from year fixed-effects and socio-demographic controls not reported due to space limitations (available upon request).
Heteroskedasticity-robust standard errors are in brackets. Standard errors are clustered at household level. *P<0.10. ** P<0.05. *** P<0.01

Implications

Our research shows that the maintenance status of a home has a statistically and economically significant effect on the health of residents. We find effects not only for indicators of well-being, such as mental and physical health, but also for the extent to which people

use the medical system through visits to the doctor. We find especially large effects for the elderly: a 23 percent more frequent visit to the GP for citizens aged 64 and older. Considering the magnitude of this effect and the fact that older people are already making more use of the health care system, the external social costs of inadequate housing maintenance are quite substantial. And given the demographic developments (i.e. an aging population), these costs will only increase further in the coming decades.

Finally, back to the COVID-19 crisis. The lock-down policies are forcing us to spend time in our own home. Stay home, stay healthy. The fact that we mainly find health effects for the elderly could indicate two possible transmission channels between home maintenance and health. First, the elderly may be more sensitive to external health shocks. This would be in line with previous research into the effects of heat and cold waves and salmonella poisoning, which also affected the elderly disproportionately (Bind et al., 2016), just as now with the Corona virus. However, this effect may also be due to greater exposure to the indoor climate of the home. Citizens aged 64 and older spend a lot of time indoors and the indoor climate in that house can have greater consequences for their health. This has recently been true for all of us.

From existing research, we know that increased concentrations of small dust particles and CO_2 levels have a direct effect on cognitive performance on office workers (Allen et al., 2016) and on chess performance (Kuenn et al., 2019). The productivity of people working from home is therefore likely to be influenced by the indoor climate in the home, and thus by the quality of home maintenance. After all, home maintenance contributes to the quality of the indoor climate.

In view of these findings, it is time to address the overdue maintenance of our housing stock, quickly. This is especially true for rental properties, but in the current stimulus packages the government can also provide for a larger deduction for investments in owner-occupied homes – good for the economy and good for health!

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