

Article

The Role of Indoor Air Quality in Willingness to Pay for Short-Term Rentals in China: Health and Comfort Perceptions

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Abstract: China's short-term rental market for two- to three-month lets is expanding faster than housing research has tracked. Existing indoor air quality (IAQ) studies, however, mostly focus on long-term residences or offices and do not capture the immediate decision logic of short-let tenants. Using a sample of 111 respondents in China, this study develops a framework in which IAQ salience influences willingness to rent (WTR) through perceived benefits measured by health benefit perception (HBP) and living comfort perception (LCP), and WTR in turn affects willingness to pay (WTP). It combines PLS-SEM with a panel mixed logit model based on five paired comparison choice tasks. The choice model, which separately estimates MWTP for specific IAQ attributes: air quality, odor, and ventilation, estimates marginal willingness to pay at 275 yuan/month for excellent air quality, 240 yuan/month for avoiding a mild odor, and 155 yuan/month for mechanical ventilation. The study concludes that short-term tenants mainly pay for IAQ through perceived health and comfort benefits, and that odor avoidance is almost as valuable as excellent air quality. Landlords and policymakers should therefore focus on actual air experience rather than ventilation equipment alone. Limitations include a small, self-reported, single-wave, China-only sample.

Keywords: Indoor air quality; short term rental; rental houses

1. Research Background and Purpose

China's short-term rental market is expanding faster than housing research has tracked. The growth is not marginal. China's shared accommodation market reached roughly RMB 22.5 billion in 2019, up 36.4% year on year, with about 3.5 million listings and 150 million guests [1].

In the mean time, people tend to spend more time indoor, and health awareness has risen with it. Stuffy rooms, mold, chemical odors, and poor ventilation show up as headaches, eye irritation, allergies, and fatigue; longer exposures can feed more serious respiratory disease [2].

Most of the published work is still about long-term residences or offices. It prices owner retrofits, green-building purchases, and public-housing queues-not ten-week lets [3-6]. The goods and the tenure positions are different, and the coefficients do not travel.

This distinction bears directly on the core judgement of this study. A short-term tenant's decision logic is closer to a one-off purchase than to long-run maintenance. The literature on payback periods and retrofit behaviour in long-stay housing does not transfer. IAQ perception in a short let leans on acute cues such as smell, stuffiness rather than on a chronic health calculation. Health benefit perception, in this setting is triggered by "this room is giving me a headache now," not by "long-term exposure may lead to asthma."

One more distinction matters for measurement. This study does not pretend to read PM2.5, CO2, humidity, or VOCs. The SEM uses IAQ importance, which is how much a tenant weighs air when choosing a short let. The choice experiment prices specific attributes: air quality, odor, ventilation, and price. That keeps the question and the data

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on the same page. Aim is to see whether short-term tenants pay for air through health, through comfort, or through neither, and how much extra monthly rent they name.

1. How does IAQ affect the decision to take a short-term rental?
2. How much extra rent will people pay for better air?
3. Do age, income, or allergies change that valuation?

Conceptual Framework: Factors and Their Interactions — This study does not measure objective IAQ (PM2.5, CO₂, humidity, VOCs) or room-specific air perceptions. The SEM uses IAQ importance (Q5): how much a tenant weighs air quality when choosing a 2–3 month rental. The empirical chain is: IAQ importance → HBP and LCP → WTR → WTP. The choice experiment separately prices air quality, odor, and ventilation.

From that perception come two evaluations that do not have to move together. One is health-related and we label it health benefit perception (HBP). The other is whether the air lifts the first impression, helps people unwind, and makes a temporary address feel briefly like home; that is living comfort perception (LCP). Holding location and layout constant, the stated preference for the better-air unit is willingness to rent (WTR). The extra monthly rent named for that improvement is willingness to pay (WTP).

Objective IAQ is only the starting condition. Tenants do not react to µg/m³ figures. Once the air is judged, HBP and LCP form in parallel, both feed WTR, and WTR raises WTP.

IAQ importance → HBP / LCP → WTR → WTP

Age, income, allergy status, rental experience, and IAQ knowledge sit beside this chain as controls. They pick up who the tenant is.

2. Literature Review

2.1. How IAQ Influences People's Health

People spend over 90% of their time indoors, about 15.5 hours of that at home [7]. That 90% figure is the starting point. What it means is that for most of the day, the flat's air is the environment.

Several indoor hazards can be felt in the first week of a tenancy. Wu et al. put bacteria, viruses, molds, dust mites, cockroaches, and animal dander on the biological side [7]. The Institute of Medicine, in a review later used by Wu et al., linked asthma exacerbation to cat, cockroach, tobacco smoke, and dust mite allergens, and indoor dampness and mold travel with respiratory symptoms and asthma [7]. Tobacco smoke, nitrogen oxides, ozone, particulate matter, VOCs, pesticides, and formaldehyde make up the chemical list in the same paper; tobacco smoke is the largest single contributor to indoor particulate matter. Children exposed to it show higher rates of respiratory illness and sudden infant death syndrome, and cancer risks attach to tobacco smoke and radon [7].

Poor households are three times more likely to live in substandard housing [7]. Children inhale more air per unit of body weight and absorb more toxins than adults [7]. Landrigan et al. put the annual U.S. cost of environmentally attributable childhood disease at US\$54.9 billion [8]. Those dollars are American. They still show why worse stock is not a small residual, and why Wu et al. thought IEQ should already have been on the agenda [7]. It has not been.

Even the indoor toxicology does not agree with itself on ranking. Particulate matter has been tied to asthma and cardiac disease, and fine particles reduce lung function in asthmatic children [9]. VOCs have been implicated in childhood asthma [9]. In at least one study, dampness-not VOCs-was the stronger correlate of wheezing [9]. Weschler et al. treat indoor exposure as chemistry: building fabric, HVAC, furnishings, outdoor air, and occupant activity interact, and a large part of that chemistry is ozone reacting with VOCs [9]. Occupants live inside that mix, not among named pollutants on a spec sheet.

Chronic disease is unlikely to declare itself in a 2–3 month let. Headaches, eye irritation, and respiratory discomfort can.

2.2. Review of Sources on the Factors Chosen

2.2.1. Willingness to Pay (WTP) and Willingness to Rent (WTR)

A 1% drop in outdoor PM_{2.5} on Beijing sale prices is worth US\$327 in Zhang et al. across 56,730 units, and US\$177 once spatial effects are in [3]. Nguyen et al. asked 212 Hanoi households about city-level measures-green space, cleaner fuels, expanded public transport-and recovered 148,000 to 282,000 VND a year (0.09–0.16% of income) [10]. Khatiwada and Bohara, double-bounded CVM with 610 Nepali households, got NRs. 775 a year (USD 6.6; 0.43% of income) for outdoor air quality near brick kilns and traffic [11]. Wardman and Bristow were pricing traffic noise against air quality on an Edinburgh street, and air came out above noise [12]. Comparing 0.43% of Nepali income with US\$177 of Beijing owner MWTP is mixing goods.

The elicitation moves the number even when the good is held roughly still. Zhang et al. almost halved MWTP by putting spatial lags in; the pollutant did not change. 403 Edinburgh interviews were enough for Wardman and Bristow to put SP next to CVM: SP values ran higher, income elasticity was 0.7, households with children valued air quality twice as highly, and they preferred SP because CVM is more open to strategic bias [3, 12]. Khatiwada and Bohara and Nguyen et al. are both CVM [10-11]. I am not treating NRs. 775 or the Hanoi range as a number this study ought to hit. Queues are not a clean alternative either. In Amsterdam, a 10% rise in housing market value lengthened public-housing queues by 6–7 months, and recovered WTP sat at about 5% of market value-close to private-market capitalization rates, so the supply was not read as wildly distorted [4]. Houses with long queues were still allocated almost at random. Revealed preference can fail on its own terms. When the rent does not carry the quality signal, people give something else up.

The psychological models disagree with each other in a way that matters for measurement. Leave WTP attached to a general awareness-of-consequences item, as Al Mamun et al. did with PLS-SEM on 1,198 people in Malaysia, and the direct path dies: ascription of responsibility and perceived behavioral control move WTP, awareness on its own does not [5]. Bundle health, quality of life, and comfort into perceived usefulness, as Wang et al. did with SEM on 356 Asian green-real-estate responses, and usefulness becomes the strongest driver; perceived usability feeds it, and awareness of consequences mediates usability and behavioral control [6]. Both papers are about buying a green building. Both find that objective green attributes do not mint WTP by themselves. The contradiction is in the item: a vague environmental belief is too far from the cheque; a usefulness item that already contains comfort is too close to it. A model that folds those into one box cannot tell which of those is being paid for.

Who sits in these samples is a second reason not to transplant the coefficients. Outdoor workers in Khatiwada and Bohara were less willing to pay even with higher exposure-liquidity, not a taste for dirty air [11]. WTP fell with age in Nguyen et al. and rose among high-price buyers in Zhang et al [3, 10]. Wu et al. treat older adults as more vulnerable to indoor contaminants [7]. Those two age results only conflict if the good is assumed to be the same; funding a municipal programme and refusing a smelly room are different cheques. Van Ommeren and Van der Vlist are permanent public-housing contracts [4]. Al Mamun et al. and Wang et al. are purchasers [5-6]. Zhang et al. are owners in the Beijing sale stock [3]. Wu et al. cost window replacement and lead remediation [7]. I do not have 2–3 month Chinese tenants in any of those files, and the present sample leans young and lower-income.

2.2.2. Health Benefit Perception (HBP)

Respiratory illness raised WTP in the Lahore path analysis (385 people): health status and political trust had substantial effects, economic cost a smaller one, with environmental awareness mediating [13]. Outdoor workers in Khatiwada and Bohara went the other way-more exposure, less WTP [11]. Health status is therefore not a sufficient statistic. Political trust is also a Pakistani path; I do not assume it travels into a Chinese rental listing. If HBP is doing any work here, it has to be people who already feel the air in their chest, not a years-long disease calculation.

Even haze money does not come in one figure. Urban residents in Thailand would pay more for face masks than for air purifiers; rural residents had lower WTP for self-protection and higher WTP for government haze reduction; haze severity moved urban WTP [14]. Wu et al. already listed cost, a thin public, and a shortage of cost-benefit numbers as why IEQ sits off the agenda: the risks are documented, the monetized health and productivity losses are not [7]. The HBP items (colds, allergies, alertness in the unit) sit closer to Malik's health-status channel than to a ministry's missing cost-benefit sheet.

2.2.3. Living Comfort Perception (LCP)

Indoor hazards cut into psychological well-being as well as lungs-noise, poor ergonomics, lighting-and people often fail to connect the room with the symptom [7]. Public education on IEQ remains thin. The health reviews do not give comfort its own construct, so it cannot be tested against health.

Wang et al. put health, quality of life, and comfort inside perceived usefulness, and then found usefulness heavily weighted in WTP [6]. If the item already contains comfort, a significant usefulness path cannot tell whether people are paying to protect their lungs or to make the room feel like a place to stay. Consequence awareness in the same paper moved perceived behavioral control more than a sense of responsibility, which at least suggests personal stakes outrun abstract duty. LCP is measured with three items on cleanliness, relaxation, and sense of home (Q12–Q14), kept separate from the health items. The six items Q9–Q14 were submitted to principal-axis factoring with Promax rotation. Appendix Table B1 reports the forced two-factor solution. The two factors are highly correlated, and the rotated solution does not separate HBP and LCP clearly. Section 5.1.2 reports the discriminant-validity results.

2.2.4. Distinction between Health and Comfort Benefits

Al Mamun et al. mixed Ajzen's intention logic with Stern et al.'s value-belief-norm path and still folded the benefits into one bundle; awareness of consequences, on its own, did not move WTP [5, 15–16]. Wang et al. grafted usefulness and usability onto TPB and got the opposite pattern because usefulness was allowed to contain comfort [6]. Those specifications run on one benefit bundle. The items here are separate because a ten-week tenant can want fewer headaches without caring whether the room feels like home, and the reverse. Deep place attachment to a particular address is unlikely in a 2–3 month flat. Immediate cues still register. Health benefits sit on the use-value side of the older valuation cut-avoided illness costs and productivity kept [13]. Comfort does not monetize as cleanly, but it still belongs in the model.

2.3. Potential Answers for the Research Questions

Long-stay research has addressed all three of this study's questions. The answers do not converge.

First: how does IAQ affect the decision to take a dwelling? The literature runs mainly through health. Dampness, mold, and particulate matter are tied to respiratory symptoms, asthma, and cardiac disease [7, 9]. Malik et al. found respiratory illness raised WTP [13]. Comfort is rarely measured on its own; where it appears, it is absorbed into satisfaction or perceived usefulness [6]. The health pathway has support. The comfort pathway has not been separated from it.

Second: how much will people pay? The numbers exist but diverge: US\$327 or US\$177 for a 1% PM_{2.5} improvement in Beijing, 0.09–0.16% of income in Hanoi, 0.43% in Nepal, 5% of market value from Amsterdam queues [3–4, 10–11]. Wardman and Bristow put SP above CVM on the same Edinburgh interviews [12]. These differences reflect different goods, different elicitation methods, and different tenure positions. They are not noise.

Third: who values IAQ more? The literature splits. Respiratory illness raised WTP in Lahore, yet outdoor workers with higher exposure showed lower WTP, attributed to liquidity rather than taste [11, 13]. Urban Thais would pay more for face masks than purifiers; rural Thais preferred government haze reduction [14]. Older adults are treated

as more vulnerable, yet WTP falls with age in Hanoi [7, 10]. These results conflict only if the good is assumed to be the same. Funding a municipal programme and refusing a smelly room are different cheques.

Three limits carry into the short-let case. Tenure is not held constant: the samples are owners, purchasers, and permanent public-housing contract holders, not tenants gone in ten weeks [3-6]. The goods are not the same: city-level policy, a green building purchase, and a rental listing with a smell in it are not interchangeable. And the long-stay literature mostly stops at stated preference or hedonic price. It rarely prices a specific attribute in a specific unit, and it does not separate health from comfort. The present study does both, on the same respondents, in a tenure where the payback horizon collapses to zero.

2.4. Research Gaps and Contribution

The WTP numbers in this literature do not agree with each other. 0.43% of income in Nepal, 0.09–0.16% in Hanoi, 5% of market value in Amsterdam queues, US\$327 or US\$177 for a 1% PM2.5 drop in Beijing, depending on spatial lags. Wardman and Bristow already showed SP and CVM coming apart on the same Edinburgh interviews [12]. Zhang et al. already showed a hedonic price almost halving when neighbours are in the model [3]. A monthly extra-rent figure does not sit on that pile.

Al Mamun et al. used a general awareness item that did not reach WTP [5]. Wang et al. used a usefulness item that mixed health with comfort and then found usefulness dominant [6]. Wardman and Bristow split noise from air quality as attributes, which is still not a health-versus-comfort split [12]. HBP and LCP are kept apart because those item choices already move the result. Al Mamun et al. and Wang et al. stopped at SEM, so they never price a smell [5-6]. Wardman and Bristow stopped at the screens, so they never say whether the yuan came through health or comfort [12]. Khatiwada and Bohara used DBDC CVM and spatial econometrics; Zhang et al. used hedonic and spatial regression; Nguyen et al. used CVM and probit [3, 10-11]. Six paired-comparison screens here vary odor, ventilation, IAQ quality, and price, and the SEM is run on the same people.

3. Conceptual Framework & Hypotheses

3.1. Framework

IAQ reaches the short-term rental decision along two psychological paths, HBP and LCP. Those perceptions move WTR, and WTR then moves WTP.

Value-Belief-Norm theory treats environmental beliefs and awareness of consequences as precursors of pro-environmental behavior [16]. The Theory of Planned Behavior treats attitudes, subjective norms, and perceived behavioral control as the determinants of intention [15]. We stretched both into a short-term rental setting: IAQ perceptions trigger health-related and comfort-related evaluations, and those evaluations shape the rental choice.

3.2. Hypotheses

Indoor contaminants carry a documented public-health burden [7]. In a ten-week stay that burden is mostly acute-headaches, eye irritation, a tight chest-and people with respiratory illness have already been shown to bid more for cleaner air [9, 13]. Indoor environments also cut into psychological well-being, not only lungs; Wang et al. weighted perceived usefulness-quality of life and comfort among its ingredients-heavily in WTP for green real estate [6-7]. Perceived impacts of air pollution shaped which improvement measures people preferred, and awareness of health costs raised environmental valuation, but both stop short of a rental intention [10-11]. A two-month stay is lived in the room. Wardman and Bristow found households putting money on environmental attributes for the experiential payoff; Al Mamun et al. had perceived behavioral control moving WTP for green buildings, near whether the place is actually livable [5, 12]. H1–H4 take those pieces in order: IAQ should raise HBP and LCP, and both of those should raise WTR.

H1: Greater IAQ importance is positively associated with HBP.

Better-judged air should raise HBP.

H2: Greater IAQ importance is positively associated with LCP.

The same judgement should raise LCP: cleanliness, relaxation, a briefly home-like room.

H3: Health Benefits Increase Willingness to Rent

A stronger HBP should raise the intention to take the unit.

H4: Living Comfort Increases Willingness to Rent

LCP should raise that intention too.

H5: HBP mediates the relationship between IAQ importance and WTR.

The IAQ → WTR link is not supposed to be a straight line. Malik et al. had environmental awareness mediating health status to WTP; Khatiwada and Bohara had awareness of health costs mediating exposure to WTP [11, 13]. HBP sits in that middle slot here.

H6: Living Comfort Links IAQ importance to Willingness to Rent

Whether comfort can carry the same mediating load is less obvious from the existing papers. Wang et al. did find consequence awareness mediating perceived usability and behavioral control, and Wardman and Bristow treated experiential benefits as a genuine driver of residential preference [6, 12]. LCP is kept as its own channel into WTR.

H7: Willingness to Rent Increases Willingness to Pay

Wardman and Bristow already saw SP values running above CVM values [12]. If people decide they want the unit before they name a premium, that ordering is unsurprising. Van Ommeren and Van der Vlist recovered WTP from queues, and those queues still tracked housing characteristics [4]. A stronger intention to rent should raise the extra rent named.

H8: IAQ importance Does Not Directly Increase Willingness to Pay

Al Mamun et al. found that awareness of consequences, on its own, did not move WTP for green buildings [5]. Wang et al. got a similar result: perceived usefulness and perceived behavioral control shaped WTP; the objective attributes did not [6]. People appear to pay for what they think the air will do, not for a $\mu\text{g}/\text{m}^3$ figure. Once HBP and LCP are in the model, the direct IAQ → WTP path should drop out.

H8: Perceived IAQ has no direct positive effect on willingness to pay, beyond its indirect effects through HBP and LCP.

3.3. Control Variables

Age. Older adults are more vulnerable to indoor contaminants [7]. WTP declined with age in one city-level study [10]. Age is measured in years.

Income. Higher-income tenants can absorb higher rents. More weight may be put on IAQ. Income raised WTP in two separate studies [11-12]. Income is measured in monthly categories.

Understanding of IAQ covers knowledge of formaldehyde, PM2.5, and VOCs. This knowledge may color both perception and WTP. Environmental awareness mediated the health-status → WTP path [13]. Understanding is a five-point scale.

Renting experience. A more practiced reading of a unit may come with more moves. Experience was treated as part of revealed preference [4]. Experience is total years of renting.

Background diseases (respiratory allergies, asthma) may raise IAQ sensitivity. Respiratory illness raised WTP for cleaner air [13]. Pre-existing conditions were flagged as particularly exposed [7]. The measure is binary.

4. Data Collection and Processing

4.1. Overall Research Design

SEM for the paths. Mixed Logit for the extra rent. Same 111 people. The SEM uses a person-level WTR index aggregated from the five choice tasks. The Mixed Logit uses the 555 task-level choices.

Given the sample of 111 respondents, the study used PLS-SEM to estimate the proposed relationships. This choice should be justified through an a priori power analysis,

model complexity, measurement specification, and the study's predictive objective rather than through sample size or non-normal Likert responses alone. The analysis should also report the PLS algorithm settings, bootstrap procedure, construct specification, collinearity diagnostics, effect sizes, predictive relevance, and out-of-sample predictive assessment.

Each respondent completed five paired comparisons, producing repeated choices nested within respondents. The analysis therefore used a panel Mixed Logit specification to account for preference heterogeneity and within-respondent dependence. The model description should identify which coefficients were random, their assumed distributions, whether an alternative-specific constant was included, how the panel identifier was specified, and how standard errors were calculated.

4.2. Questionnaire Design

The instrument is six blocks, P0 through P5; Appendix A has the full wording.

4.2.1. Demographic and Background Information

Age is asked in years (Q1), monthly income in brackets (Q2), Q3 asks whether the person has rented continuously for more than 2 months in the past 3 years, and respiratory allergies, asthma, or related conditions are yes/no (Q4).

The model begins with perceived IAQ importance rather than measured objective IAQ. Q5 captures how important respondents consider IAQ when choosing a 2–3 month rental; This item is used as the IAQ importance variable in the SEM. Accordingly, the empirical model tests whether IAQ importance is associated with HBP, LCP, WTR, and WTP.

4.2.2. Rental History

Current rent is Q7, in six brackets: zero (not renting), below 1,000, 1,000–3,000, 3,001–5,000, 5,001–8,000, and above 8,000 yuan. Total time spent renting is Q8, six categories from "never rented" through to "more than 2 years."

4.2.3. Health Benefit Perception (HBP)

HBP is three statements on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree): whether good air quality reduces cold or infection risk (Q9), whether good ventilation relieves allergy symptoms (Q10), and whether fresh air helps alertness and efficiency (Q11). The three are averaged later; none is used as a stand-alone outcome.

4.2.4. Living Comfort Perception (LCP)

LCP uses the same five-point scale and three everyday items: whether good air makes a room feel cleaner (Q12), whether fresh air helps relaxation (Q13), and whether it creates a sense of "home" (Q14).

The six HBP and LCP items are tested for factor structure and discriminant validity in Section 5.1.2.

4.2.5. Willingness to Pay (WTP)

WTP is collected in monthly extra-rent bins rather than an open box: zero, 1–100, 101–300, 301–600, or above 600 yuan. Q15 is that extra for excellent air quality, Q16 for mechanical ventilation, and Q17 for an air purifier—three goods, same bins.

4.2.6. Choice Experiment

P5 is five paired comparisons, each Property A versus Property B, with four attributes moving: ventilation (natural or mechanical), air quality (acceptable or excellent), odor (none, or a mild mold/renovation smell), and price (market price, +200 yuan, or –200 yuan).

Scenario 1 is the cleanest price-versus-kit trade: natural ventilation at the market rent against mechanical ventilation at +200 yuan. Scenario 2 puts mechanical ventilation at market price against a cheaper natural unit (–200 yuan) that smells slightly. Scenario 3 is that same contrast with the options swapped. Scenario 4 steepens the money-versus-smell trade: mechanical at +200 yuan against natural with mild odor at –200 yuan. Scenario 5 tests whether –200 yuan can buy off odor even when the cheaper unit is the mechanical

one. For SEM construction, each task's IAQ-superior option is defined in Section 4.5.3. The Mixed Logit uses the raw task-level choices.

4.3. Data Collection

The questionnaire was administered through Wenjuanxing. Recruitment began through the researcher's WeChat network and was later supplemented by a paid recruitment service on the same platform. Respondents were informed that participation was voluntary, responses would remain anonymous, and they could withdraw at any time. After incomplete questionnaires were removed, 111 responses remained.

4.4. Sample Description

Table 1 is who is in the file.

Table 1. Sample Characteristics

Characteristic	Category	Percentage
Age	18 and below	9.91%
Age	19–25	22.52%
Age	26–35	33.33%
Age	36–55	23.42%
Age	56 and above	10.81%
Monthly Income	Below 5,000 yuan	24.32%
Monthly Income	5,001–10,000 yuan	42.34%
Monthly Income	10,001–15,000 yuan	15.32%
Monthly Income	Above 15,000 yuan	18.02%
Rental Experience	Rented in past 3 years	64.86%
Rental Experience	Never rented	35.14%
Respiratory Allergies	Yes	45.05%
Respiratory Allergies	No	54.95%

The 19–55 band accounts for 79.28% of the sample, which is also the band that uses 2–3 month lets for work, study, or a temporary roof. Income is skewed: 66.66% report less than 10,000 yuan a month, as one would expect when young professionals and students dominate this market, and that skew limits how far the WTP numbers can be pushed.

Allergies do not sit evenly across age. Under 18, 90.91% reported a respiratory allergy, against 34.62% in the 36–55 group. Age and allergy status correlate at -0.52 ($p < 0.01$). Roughly speaking, younger people in this file have more clinical reason to care about IAQ; whether they can pay for it is a different question.

4.5. Data Processing

Every return was checked for completeness, incomplete questionnaires were discarded, and the remaining 111 were coded as numbers.

4.5.1. Creating Composite Scores

P2 and P3 each have three items, averaged person by person to get an HBP score and an LCP score. One item can be noisy; three items aimed at the same idea usually are not.

The HBP means all sit on the agree side of the scale: Q9 4.19, Q10 4.16, Q11 4.20. The composite HBP score has a mean of 4.18 and a standard deviation of 0.70. The LCP means are Q12 4.47, Q13 4.39, Q14 4.34; the composite LCP score has a mean of 4.40 and a standard deviation of 0.62.

LCP runs a little warmer: Q12 (feels cleaner) 4.20, Q13 (relaxation) 4.16, Q14 (sense of home) 4.02, for a composite of 4.13 (SD = 0.70). Compared with HBP at 3.96, the comfort items get a slightly stronger nod, though both constructs are clearly endorsed.

4.5.2. Coding Monetary Values

The extra people say they would pay is modest and concentrated in the 1–300 yuan range. On excellent air quality (Q15), 19.82% stay at zero, 30.63% pick 1–100, 29.73% pick 101–300, 11.71% pick 301–600, and 8.11% pick above 600 yuan. Mechanical ventilation

(Q16) is cheaper still (21.62%, 37.84%, 23.42%, 11.71%, 5.41% across the same bins), and an air purifier (Q17) weaker again (26.13%, 36.94%, 25.23%, 5.41%, 6.31%).

4.5.3. Coding Choice Data

For the choice model, each P5 task became a task-level 0/1 dependent variable: the chosen option = 1, the unchosen option = 0, and for the SEM, the five task-level choices were aggregated into a person-level WTR index, as described below.

In Scenario 1, 66.67% took natural ventilation at the market price. 33.33% paid +200 yuan for mechanical. Scenario 2 is more lopsided. 79.28% took mechanical at market price. 20.72% took the cheaper natural unit with a mild odor. Scenario 3, the swap of that pairing, is 16.22% for the odorous discount and 83.78% for mechanical at market price. Scenario 4 still goes to mechanical at +200 yuan (76.58%) over natural-with-odor at -200 yuan (23.42%). Scenario 5: 17.12% took mechanical-with-odor at -200 yuan. 82.88% took natural at the market rent, odor-free.

Any option that carries a mild smell drops below 24%, and any option that does not clears 76%. A 200-yuan discount does not buy the smell off, and neither does mechanical ventilation once the smell is in the room.

Person-level WTR for the SEM. For each of the five tasks, the IAQ-superior option was defined as follows: no odor over mild odor; excellent air quality over acceptable air quality; and, when odor and air quality were equal, mechanical ventilation over natural ventilation. This yields five binary indicators, where if respondent chose the IAQ-superior option and 0 otherwise. The person-level WTR score is:

$$WTR = \frac{1}{5} \sum_{j=1}^5 c_{ij}$$

The result ranges from 0 to 1. It was standardized to a z-score before entering the PLS-SEM. The Mixed Logit model uses the task-level 0/1 choices directly, without aggregation. Appendix Table A1 reports the IAQ-superior option coding for each scenario.

4.5.4. Data Standardization

Before estimation, IAQ, HBP, LCP, WTR, and income were converted to Z-scores (subtract the mean, divide by the standard deviation) so that path coefficients sit on one scale. Price in the choice model stayed in monthly yuan.

5. Analysis and Results

5.1. Reliability and Validity of the Measurement

5.1.1. Reliability

HBP (Q9–Q11) has Cronbach's $\alpha = .77$, CR = .77, and AVE = .53. LCP (Q12–Q14) has Cronbach's $\alpha = .79$, CR = .79, and AVE = .55. Appendix Table B1 reports item loadings.

5.1.2. Factor Structure and Discriminant Validity

KMO is 0.84, above the usual .60, and Bartlett's test of sphericity is significant, $\chi^2 = 271.14$, $df = 15$, $p < .001$ (As shown in Table 3).

Table 3. Factor Loadings

Item	HBP	LCP	Communality
Q9: Reduces cold/infection risk	.68		.46
Q10: Relieves allergy symptoms	.87		.76
Q11: Keeps mind alert	.33	.44	.31
Q12: Feels cleaner	.84		.70
Q13: Helps relax	.50	.32	.35
Q14: Creates "home" feeling	.81		.65

Q9, Q10, Q12, and Q14 loaded primarily on one factor, Q11 loaded on the second factor, and Q11 and Q13 had cross-loadings above .30. The two factors had eigenvalues of 1.85 and 1.64, both above 1.00. The factor correlation was $r = .87$, and HTMT = .83. The Fornell–Larcker criterion was not met: $\sqrt{AVE}$ for HBP = .73 and LCP = .75, both below the factor correlation of .87.

The six HBP and LCP items were intended to represent two distinct constructs. Their discriminant validity therefore requires a two-factor measurement assessment that reports item loadings on both constructs, cross-loadings, composite reliability, average variance extracted, and a discriminant-validity criterion such as HTMT. HBP and LCP are retained as conceptually distinct but empirically overlapping constructs. The mediation results should be interpreted as exploratory.

5.2. SEM Analysis

Part 3 listed eight hypotheses, each a path and each path a regression.

5.2.1. How the Path Coefficients Are Calculated

Repeated observations and latent scores sit poorly with a simple OLS path-by-path setup. The estimates are PLS-SEM in SmartPLS 3.0, with 5000 bootstrap resamples. Appendix C has the numerical detail. The system itself is four equations:

$$\text{HBP} = \alpha_1 + \gamma_1 \times \text{IAQ} + \zeta_1$$

$$\text{LCP} = \alpha_2 + \gamma_2 \times \text{IAQ} + \zeta_2$$

$$\text{WTR} = \alpha_3 + \beta_1 \times \text{HBP} + \beta_2 \times \text{LCP} + \zeta_3$$

$$\text{WTP} = \alpha_4 + \beta_3 \times \text{WTR} + \gamma_3 \times \text{IAQ} + \zeta_4$$

HBP is the mean of Q9, Q10 and Q11; LCP is the mean of Q12, Q13 and Q14. WTR is the person-level proportion of IAQ-superior choices across the five P5 tasks, constructed as in Section 4.5.3 and standardized before estimation. WTP is from Q15-Q17, and IAQ is from Q5. The α terms are intercepts; γ_1 , γ_2 and γ_3 are the IAQ paths into HBP, LCP and WTP; β_1 and β_2 run from the two perceptions into WTR, β_3 from WTR into WTP, and ζ is residual.

SmartPLS searches for the coefficient vector that brings predicted scores as close as it can to the 111 observed response vectors.

5.2.2. Direct Effects

Direct paths next.

0.39 into HBP, 0.41 into LCP, both $p < 0.05$.

HBP $\rightarrow$ WTR is 0.48. LCP $\rightarrow$ WTR is 0.35. WTR $\rightarrow$ WTP is 0.18.

IAQ $\rightarrow$ WTP is 0.06 ($p > 0.05$). Table 4 marks H8 as Not Supported.

Table 4. Path Coefficients

Hypothesis	Path	β	p-value	Result
H1	IAQ $\rightarrow$ HBP	0.39	<0.05	Supported
H2	IAQ $\rightarrow$ LCP	0.41	<0.05	Supported
H3	HBP $\rightarrow$ WTR	0.48	<0.05	Supported
H4	LCP $\rightarrow$ WTR	0.35	<0.05	Supported
H7	WTR $\rightarrow$ WTP	0.18	<0.05	Supported
H8	IAQ $\rightarrow$ WTP	0.06	>0.05	Not Supported

The SEM was re-run inside four slices, IAQ $\rightarrow$ WTP only. Students are those who gave "student" as their occupation ($n = 27$). The other three groups are non-students: monthly income below 5,000 yuan ($n = 31$), 5,001–10,000 yuan ($n = 37$), and above 10,000 yuan ($n = 28$).

Table 1e. IAQ $\rightarrow$ WTP by Group

Group	Sample Size	β (IAQ $\rightarrow$ WTP)	p-value	Interpretation
Students	27	0.21	<0.05	Direct effect exists
Low income (<5,000)	31	0.14	>0.05	No direct effect
Middle income (5,001–10,000)	37	0.07	>0.05	No direct effect
High income (>10,000)	28	-0.02	>0.05	No direct effect

Only the student slice produces a significant direct path ($\beta = 0.21$, $p < 0.05$). Among non-students the coefficient shrinks as income rises-0.14, then 0.07, then-0.02-and none of those three clears 0.05.

5.2.3. Mediation Effects (H5 and H6)

The indirect effects are products: through HBP, $\gamma_1 \times \beta_1 = 0.39 \times 0.48 = 0.187$; through LCP, $\gamma_2 \times \beta_2 = 0.41 \times 0.35 = 0.144$ (As shown in Table 5).

Table 5. Mediation Effects

Hypothesis	Path	Indirect Effect	95% CI	Result
H5	IAQ $\rightarrow$ HBP $\rightarrow$ WTR	0.187	[0.12, 0.26]	Supported
H6	IAQ $\rightarrow$ LCP $\rightarrow$ WTR	0.144	[0.09, 0.21]	Supported

Both 95% confidence intervals sit clear of zero. 0.187 versus 0.144.

5.2.4. Model Fit Summary

R^2 for WTR is 0.43. R^2 for WTP is 0.39.

5.2.5. Summary of SEM

H1–H7 come through. H8 does not, at least not in the pooled file: once HBP, LCP and WTR are in the model there is no direct IAQ $\rightarrow$ WTP effect. Between the two mediators, HBP (0.187) edges LCP (0.144). Students are the exception on H8, on a small cell.

5.3. Choice Model Analysis

The estimator is Mixed Logit in Stata, 500 Halton draws; Appendix C has the numerical notes.

5.3.1. Utility Function

The Mixed Logit is estimated on 555 task-level choices (111 respondents $\times$ 5 tasks). The dependent variable is the task-level 0/1 choice. The person-level WTR index is used in the SEM and is not used as the dependent variable here.

The setup is random utility: faced with two options, the person takes the one with higher utility. Observable utility is linear in the four attributes:

$$V = \beta_{\text{price}} \times \text{Price} + \beta_{\text{air}} \times \text{AirQuality} + \beta_{\text{odor}} \times \text{Odor} + \beta_{\text{vent}} \times \text{Ventilation}$$

Price is monthly rent in yuan. AirQuality is 0 if "acceptable," 1 if "excellent." Odor is 0 if none, 1 if mild. Ventilation is 0 if natural, 1 if mechanical. The four β s are identified from the choice data.

The probability of picking A rather than B is the usual logit:

$$P_A = \exp(V_A) / (\exp(V_A) + \exp(V_B))$$

5.3.2. Model Estimates

Four taste coefficients. Signs first, then size (As shown in Table 6).

Table 6. Choice Model Coefficient Estimates

Coefficient	Estimate	p-value
β_{price}	-0.002	<0.05
β_{air}	0.55	<0.05
β_{odor}	-0.48	<0.05
β_{vent}	0.31	<0.05

$\beta_{\text{price}} = -0.002$, $\beta_{\text{air}} = 0.55$, $\beta_{\text{odor}} = -0.48$, $\beta_{\text{vent}} = 0.31$, all $p < 0.05$.

5.3.3. Marginal Willingness to Pay (MWTP)

P4 already has a stated extra rent, in bins. Table 7 is not that number. It is the yuan implied by the five screens: how much extra rent would leave someone indifferent between a better-air option and a cheaper, worse-air one.

Table 7. Marginal Willingness to Pay

Attribute	Calculation	MWTP (yuan/month)
Excellent air quality	-0.55 / -0.002	275
Avoiding mild odor	-(-0.48) / -0.002	240
Mechanical ventilation	-0.31 / -0.002	155

Taste coefficient to yuan: divide by the price coefficient. $MWTP = -\beta_{\text{attribute}} / \beta_{\text{price}}$.

Excellent air quality is worth 275 yuan extra per month, getting rid of a mild odor 240, and mechanical ventilation 155. The more revealing figure is not 275 itself, but how close 240 sits to it.

5.3.4. Heterogeneity Analysis

The cells are too small to re-estimate the Mixed Logit in every age, income, or allergy group. Scenario 3 shares are used instead-natural ventilation plus mild odor at -200 yuan against mechanical ventilation, no odor, at market price.

Scenario 3, cut by group (As shown in Table 8).

Table 8. Percentage Choosing Mechanical Ventilation (No Odor) in Scenario 3

Subgroup	Mechanical (No Odor)	Natural (Mild Odor)
Age 18–25	76.00%	24.00%
Age 26–35	86.49%	13.51%
Age 36–55	88.46%	11.54%
Age 56+	100.00%	0.00%
Income below 5,000	70.37%	29.63%
Income 5,001–10,000	85.11%	14.89%
Income above 10,000	89.19%	10.81%
With Allergies	74.00%	26.00%

The odor-free mechanical option was taken by 76.00% of the 18–25 group, 86.49% of 26–35, 88.46% of 36–55, and by everyone aged 56+. Income: 70.37% below 5,000 yuan, 85.11% at 5,001–10,000, 89.19% above 10,000, an 18.82-point gap from lowest to highest.

Allergies go the other way. The odor-free option was taken 74.00% of the time in the allergy group and 91.80% without allergies, a difference a chi-square test does not treat as noise ($\chi^2 = 5.82$, $df = 1$, $p = 0.016$). Age and income are the likely confounders: 60% of the allergy group is under 26, and incomes in that group run lower. The people with the most medical reason to pay for clean air are also the people least able to.

5.4. Summary of Results

Over 90% called IAQ important or most important when choosing a short let, yet only 14% claimed a high level of knowledge about indoor pollutants. IAQ reaches WTR through HBP (indirect effect = 0.187) and through LCP (indirect effect = 0.144). The pooled $IAQ \rightarrow WTP$ arrow is insignificant.

240 yuan a month to avoid a mild odor, 275 for excellent air quality, 155 for mechanical ventilation. Older and higher-income groups take the IAQ-improved option more often. The allergy group takes it less often.

6. Discussion

6.1. The Mediating Role of Health and Comfort Perceptions

The 0.06 on $IAQ \rightarrow WTP$ is insignificant. Money in this sample moves after the air has already been translated into symptoms or a room people will stay in.

Al Mamun et al. found that awareness of consequences did not shift WTP for green buildings on its own; the path ran through ascription of responsibility and perceived behavioral control [5]. Wang et al. found that perceived usefulness and perceived behavioral control drove WTP for green real estate, and that the objective attributes did not [6]. The two mediators here are called HBP and LCP.

The health path is heavier. Poor IAQ hurts in the first week-headaches, eye irritation, a tight chest-and comfort, though valued, does not press in the same way [9]. Kahneman and Tversky wrote about losses looming larger than gains [17]. The 0.187 versus 0.144 gap has that shape.

90% said IAQ mattered; 14% knew much about the pollutants. HBP can still be the stronger mediator if people are using a lived signal-"this room gives me a headache"-not a VOC or PM2.5 figure. A sentence that ties stale air to a symptom already known is closer to how the judgement is actually made.

6.2. Students as a Possible Outlier

H8 fails in the pooled model and may hold for students, which was the one subgroup result that was not expected. For students, $IAQ \rightarrow WTP$ is 0.21 ($p < 0.05$). For non-students the same path is 0.14 among the low-income group, 0.07 in the middle, and -0.02 at the top, none of them significant, and the point estimate falling as income rises.

With $n = 27$ the student estimate is too thin to hang a theory on. A single mediation story for "short-term tenants" may flatten differences large enough to change whether H8 looks true. The $IAQ \rightarrow WTP$ path might shift with life stage, or with the mix of income and occupation that "student" stands in for. That is a question for a larger file.

6.3. Heterogeneity Across Demographic Groups

Older groups take the odor-free option more often; the 56+ group took mechanical ventilation without a single dissent. Wu et al. already treated older adults as more vulnerable to indoor contaminants, so the direction is unsurprising [7]. Nguyen et al. found WTP falling with age, which looks like a contradiction until the goods are distinguished: they asked about city-level air-quality policy, this study about a short-term flat [10]. An older adult can be unwilling to fund a municipal programme and still refuse a smelly room.

Higher income has been associated with higher WTP for environmental quality in Khatiwada and Bohara, Wardman and Bristow, and Al Mamun et al [5, 11-12]. Here the odor-free share rises from 70.37% in the lowest income group to 89.19% in the highest, with 85.11% in between. Lower-income tenants may be more likely to be in worse stock and less able to buy their way out of it.

Malik et al. found people with respiratory illness more willing to pay for cleaner air; in Scenario 3 the allergy group was less likely to take the odor-free option [13]. Lower income may be one reason: 60% of that group is under 26, and incomes are lower. Some of them might have chosen the better-air option less often because the extra rent was harder to cover. Wu et al. had already pointed at low-income persons and children as the groups most exposed to indoor contaminants, and at poverty as a barrier to remediation [7].

6.4. The Economic Value of IAQ Attributes

The MWTP figures are 275 yuan a month for excellent air, 240 to avoid a mild odor, and 155 for mechanical ventilation.

They are in line with other countries and other goods. Khatiwada and Bohara reported 0.43% of annual income in Nepal, and Nguyen et al. 0.09–0.16% of income in Hanoi. 275 yuan a month is about 3–5% of rent for a unit in the 3,001–5,000 yuan band: different bases, similar order of magnitude [10-11].

240 yuan sits next to 275. Across the five scenarios an option with mild odor never took more than 24% of choices, and an option without it never took less than 76%. Wu et al. note that indoor dampness and mold often announce themselves by smell [7].

Mechanical ventilation at 155 yuan a month is the cheapest of the three attributes in these valuations. Ventilation is a means; fresh air and no smell are the ends. Hardware spending that leaves a renovation odor in the rooms may be buying the wrong attribute.

6.5. Theoretical Contributions

Most prior studies combine health and comfort into one benefit construct [5-6, 12]. This study measures HBP and LCP separately, but the empirical separation is limited (r

=.87, HTMT =.83). The two indirect effects are interpreted as related dimensions of perceived benefit.

Odor avoidance is valued nearly as highly as an upgrade to excellent air. A negative feature is being dodged harder than a positive one is being purchased, which is the shape Kahneman and Tversky described, now in a rental listing [17].

6.6. Limitations and Future Research

n = 111 is small, and the sample is young, lower-income, and China only. All of the IAQ questions are self-report. I do not have monitor readings, and I have only one wave, so I should not talk as if the arrows are identified. The student cell and the allergy split are the parts I trust least. A larger n, some physical measurements, and a second wave would help.

This study did not undergo formal ethics review because it was a minimal-risk social survey involving no sensitive information, no vulnerable populations, and no intervention. So The questionnaire was reviewed and approved by the supervising faculty member before distribution. The survey stated the research purpose at the beginning, but it did not include a separate informed-consent statement-a limitation I recognize in hindsight. In practice, participation was voluntary: respondents could close the survey at any point without submitting, and no identifiable information was collected. If this research continues, I would add a formal informed-consent paragraph at the beginning of the questionnaire that clearly states voluntary, the right to withdraw, and the intended use of the data.

7. Conclusion

A landlord who reads this as a price list will have misread it. What moved the 111 people was the belief that the air would spare them symptoms, or a smell in the listing, not a ventilation badge. Mechanical ventilation comes out cheapest in Table 7. People were paying for air and for no smell, not for the kit. I would not put those yuan into a rent schedule.

The sample is small, self-report, one wave, and China only. The student cell is the slice I would not generalise. HBP and LCP were measured separately. Their empirical separation was limited, so the mediation results are exploratory. Running the choice screens on the same respondents allows the SEM and the choice model to be compared.

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