African Population and Health Research Center

Healthy Housing in Africa:

Definition, Profiles and Determinants

Samuel Iddi, Kanyiva Muindi, Hellen Gitau, Blessing Mberu

INTRODUCTION

- Housing is a key social determinant of health with implications for both physical and mental health.
- Housing conditions critical for children, their caregivers, the disabled, and the elderly who spend more than 70% of their time indoors.
- The home environment exposes occupants to various toxins including mold, air pollution from cooking/heating; and lead from paint and water supply pipes.
- Crowding exposes occupants to communicable diseases while poorly insulated homes lead to temperature extremes- impacting cardiovascular health

INTRODUCTION-1

- In the context of Covid-19, the default recommendations for workers globally include:

1. Self-isolation for those with symptoms; 2. Self-quarantine for 14 days after exposure; 3. Working from home

- These have brought adequate/healthy housing into sharp focus, raising intricate policy and program questions, such as housing quality, provision and access.
- The challenge is exacerbated by about one billion people living in urban slums highly susceptible to COVID- 19 infection due to existing housing and water and sanitation challenges.
- Our focus on healthy housing within the African context builds on basic characterization of adequate/healthy housing following the WHO definition and availability of data.
- Housing should satisfy four basic criteria irrespective of local context:
  - a finished roof that protects the occupants from weather,
  - sufficient living area so that no more than three people need to share a bedroom,
  - access in the dwelling or plot to spring water or improved piped water, and
  - improved sanitation in the form of a flush toilet or ventilated pit latrine not shared by more than two households.
- We use DHS data to assess healthy housing in Africa, based on above attributes and those defined by the WHO

METHODOLOGY

- Describe methodological approaches employed in the estimation of healthy housing in sub-Saharan Africa (SSA)
- Step 1: Selection and recode of variables
  - 8 original variable from DHS relating to housing structure and condition converted to ordinal scale.
  - main wall, roof, and floor materials,
  - type of toilet facility, source of drinking water,
  - type of cooking fuel, presence of electricity (yes=2, no=1), and frequency of smoking in households

METHODOLOGY

- Example

Classification	Code	Levels
Unimproved source	1	Bicycle with jerrycans, Cart with small tank, Other, River
		etc., Tanker truck, Unprotected spring, Unprotected well,
		River/dam/lake/ponds/stream/ canal/irrigation channel
Unpiped improved source	2	Protected spring, Protected well, Tube well or borehole
Slightly improved source	3	Bottled water, Rainwater, Sachet water
Piped improved source	4	Piped from the neighbor, Piped into dwelling, Piped to
		neighbor, Piped to yard/plot, Public tap/standpipe

- High values correspond to high housing quality

METHODOLOGY

- Step 2: Reliability assessment
  - Internal consistency measures
    - Cronbach's coefficient alpha based on covariances,
    - Cronbach's coefficient alpha based on correlations, and the
    - Guttman's Lambda-6, and
    - Composite reliability based on confirmatory factor analysis
- Assessment done using each country data

METHODOLOGY

- Step 3: Appropriateness of using Factor Analysis
  - Test of sampling adequacy using the Kaiser-Meyer-Olkin (KMO)
  - Correlation matrix of the data is an identity matrix using the Bartlett's Test of Sphericity.

- Step 4: Factor Analysis
  - One factor analysis with varimax rotation
  - Performed separately for both rural and urban for each country
  - Extraction method of factor scores - using regression method.
  - Scores (healthy housing score) are categorized into quintiles/tertiles and merged with the original data.

METHODOLOGY

- **Step 5**: Test of Validity
  - Concurrent validity test
  - Examine Pearson's correlation coefficient between HHI and Household Wealth Index (HWI) computed by the DHS
  - High correlation is desirable

RESULTS

Country	Cronbach α	Standardized Cronbach α	Guttman's λ6	Composite reliability	Number of variables used
Burkina Faso (2010)	0.72	0.72	0.73	0.74	8
Cameroon (2011)	0.78	0.82	0.81	0.82	7
Democratic Republic of	0.75	0.75	0.77	0.79	8
Congo (2013-2014)					
Ethiopia (2016)	0.78	0.78	0.79	0.80	8
Ghana (2014)	0.58	0.55	0.57	0.60	8
Kenya (2014)	0.78	0.80	0.80	0.81	7
Malawi (2015-2016)	0.64	0.64	0.66	0.67	8
Mali (2012-2013)	0.75	0.73	0.74	0.76	8
Namibia (2013)	0.82	0.82	0.84	0.84	8
Nigeria (2018)	0.71	0.68	0.70	0.71	8
Senegal (2017)	0.75	0.74	0.75	0.77	8
South Africa (2016)	0.66	0.66	0.67	0.68	8
Tanzania (2015-2016)	0.73	0.70	0.73	0.75	8
Uganda (2016)	0.71	0.67	0.70	0.72	8
Zambia (2013-2014)	0.80	0.80	0.82	0.83	8

- Good internal consistency
- Reliability measures ranging from 64-84% across countries.

RESULTS:

Table 1: Test for appropriateness of factor analysis

	KMO measure of sampling adequacy	Bartlett's Test of Sphericity		
Country	KMO	Approx. Chi-Square	df	p-value
Burkina Faso (2010)	0.83	22975.78	28	< 0.001
Cameroon (2011)	0.88	30346.14	21	< 0.001
DRC (2013-2014)	0.86	43988.57	28	< 0.001
Ethiopia (2016)	0.87	38177.07	28	< 0.001
Ghana (2014)	0.77	10603.12	28	< 0.001
Kenya (2014)	0.84	81136.47	21	< 0.001
Malawi (2015-2016)	0.76	35060.56	28	< 0.001
Mali (2012-2013)	0.87	17816.38	28	< 0.001
Namibia (2013)	0.87	31741.47	28	< 0.001
Nigeria (2018)	0.82	60926.72	28	< 0.001
Senegal (2017)	0.85	16235.07	28	< 0.001
South Africa (2016)	0.75	13248.81	28	< 0.001
Tanzania (2015-2016)	0.85	24955.66	28	< 0.001
Uganda (2016)	0.83	35344.19	28	< 0.001
Zambia (2013-2014)	0.88	46456.75	28	< 0.001

- Kaiser-Meyer-Olkin (KMO) Measure of sampling adequacy values ranged from 75-88%
- Bartlett's test of sphericity was all significant across countries
- Indicative of appropriateness of the factor analysis without any remedial action

RESULTS-1

Table 2: Test of validity: correlation coefficient between HHI and HWI		
Country	Urban	Rural
Burkina Faso (2010)	0.75	0.71
Cameroon (2011)	0.71	0.84
DRC (2013-2014)	0.92	0.77
Ethiopia (2016)	0.78	0.6
Ghana (2014)	0.72	0.67
Kenya (2014)	0.82	0.78
Malawi (2015-2016)	0.86	0.85
Mali (2012-2013)	0.69	0.81
Namibia (2013)	0.86	0.86
Nigeria (2018)	0.75	0.82
Senegal (2017)	0.81	0.8
South Africa (2016)	0.69	0.75
Tanzania (2015-2016)	0.88	0.88
Uganda (2016)	0.84	0.79
Zambia (2013-2014)	0.87	0.85

- Concurrent validity showed good association (ρ=0.69-0.92 for urban, 0.60-0.88 for rural, p-value<0.001)

PROFILES AND DETERMINANTS

RESULTS- HEALTHY HOUSING BY AREA OF RESIDENCE

	Rural		Urban	
	Unhealthy Housing	Healthy Housing	Unhealthy housing	Healthy housing
Country (year)	Freq (%)	Freq (%)	Freq (%)	Freq (%)
Burkina Faso (2010)	5059 (47%)	5780 (53%)	782 (22%)	2804 (78%)
Cameroon (2011)	3551 (51%)	3420 (49%)	1608 (22%)	5636 (78%)
Democratic Republic of Congo (2013-2014)	6826 (55%)	5604 (45%)	2085 (36%)	3656 (64%)
Ethiopia (2016)	4769 (36%)	8498 (64%)	1384 (41%)	2000 (59%)
Ghana (2014)	1558 (29%)	3774 (71%)	1277 (20%)	5226 (80%)
Kenya (2014)	9679 (46%)	11461 (54%)	2792 (18%)	12498 (82%)
Malawi (2015-2016)	13114 (59%)	9205 (41%)	983 (24%)	3059 (76%)
Mali (2012-2013)	3790 (48%)	4155 (52%)	677 (31%)	1483 (69%)
Namibia (2013)	2402 (51%)	2326 (49%)	1642 (32%)	3480 (68%)
Nigeria (2018)	8392 (39%)	13095 (61%)	3608 (19%)	15332 (81%)
Senegal (2017)	1263 (31%)	2782 (69%)	414 (10%)	3921 (90%)
South Africa (2016)	852 (24%)	2689 (76%)	803 (11%)	6739 (89%)
Tanzania (2015-2016)	4383 (52%)	4038 (48%)	1105 (27%)	3036 (73%)
Uganda (2016)	6825 (47%)	7735 (53%)	1257 (25%)	3770 (75%)
Zambia (2013-2014)	4529 (49%)	4751 (51%)	1583 (24%)	5058 (76%)

RESULTS- HEALTHY HOUSING BY SEX OF HOUSEHOLD HEAD

	Male headed		Female headed	
	Unhealthy housing	Healthy housing	Unhealthy housing	Healthy housing
Country (year)	Freq (%)	Freq (%)	Freq (%)	Freq (%)
Burkina Faso (2010)	5352 (41%)	7638 (59%)	488 (34%)	946 (66%)
Cameroon (2011)	3950 (37%)	6646 (63%)	1209 (33%)	2409 (67%)
Democratic Republic of Congo (2013-2014)	6583 (48%)	7055 (52%)	2329 (51%)	2205 (49%)
Ethiopia (2016)	4503 (36%)	7922 (64%)	1649 (39%)	2575 (61%)
Ghana (2014)	1956 (25%)	5876 (75%)	879 (22%)	3124 (78%)
Kenya (2014)	8012 (32%)	16689 (68%)	4459 (38%)	7270 (62%)
Malawi (2015-2016)	9397 (51%)	8895 (49%)	4701 (58%)	3368 (42%)
Mali (2012-2013)	4044 (44%)	5120 (56%)	423 (45%)	518 (55%)
Namibia (2013)	2153 (39%)	3370 (61%)	1890 (44%)	2436 (56%)
Nigeria (2018)	10345 (31%)	22791 (69%)	1655 (23%)	5636 (77%)
Senegal (2017)	1346 (23%)	4491 (77%)	331 (13%)	2212 (87%)
South Africa (2016)	902 (14%)	5456 (86%)	752 (16%)	3973 (84%)
Tanzania (2015-2016)	4027 (42%)	5460 (58%)	1462 (48%)	1614 (52%)
Uganda (2016)	5550 (41%)	7961 (59%)	2533 (42%)	3544 (58%)
Zambia (2013-2014)	4260 (36%)	7428 (64%)	1852 (44%)	2381 (56%)

RESULTS- HEALTHY HOUSING BY HOUSEHOLD WEALTH

	Poor	Middle	Rich
Country (year)	Freq (%)	Freq (%)	Freq (%)
Burkina Faso (2010)	1504 (26%)	1788 (64%)	5291 (89%)
Cameroon (2011)	1677 (31%)	1679 (61%)	5699 (94%)
Democratic Republic of Congo (2013-2014)	2101 (26%)	1868 (52%)	5291 (80%)
Ethiopia (2016)	2439 (38%)	2390 (77%)	5668 (80%)
Ghana (2014)	1866 (49%)	2093 (79%)	5041 (94%)
Kenya (2014)	3464 (27%)	4410 (63%)	16086 (96%)
Malawi (2015-2016)	948 (9%)	2466 (48%)	8849 (88%)
Mali (2012-2013)	1038 (25%)	1335 (67%)	3265 (82%)
Namibia (2013)	652 (18%)	1078 (55%)	4076 (96%)
Nigeria (2018)	4612 (32%)	6703 (81%)	17112 (96%)
Senegal (2017)	1529 (50%)	1495 (91%)	3680 (100%)
South Africa (2016)	2975 (66%)	2183 (97%)	4271 (99%)
Tanzania (2015-2016)	781 (17%)	1479 (59%)	4814 (87%)
Uganda (2016)	1681 (22%)	2071 (57%)	7754 (93%)
Zambia (2013-2014)	2144 (33%)	1867 (63%)	5797 (91%)

Table shows distribution of healthy housing by wealth status for each country

DETERMINANTS OF HEALTHY HOUSING

Variable	Burkina Faso (2010)	Cameroon (2011)	DRC(2013-2014)	Ethiopia (2016)	Ghana (2014)
Intercept	0.41(0.17, 1.00)	1.20(0.57, 2.52)	0.47(0.18, 1.22)	0.33(0.09, 1.21)	4.15(0.99, 17.39)
Residence (Urban)	0.23(0.16, 0.34)	0.03(0.01, 0.05)	0.14(0.09, 0.21)	0.10(0.07, 0.15)	0.11(0.08, 0.15)
Gender (Male)	0.80(0.68, 0.95)	0.65(0.57, 0.76)	0.87(0.76, 1.01)	0.98(0.85, 1.13)	0.76(0.65, 0.89)
Age (18-35years)	1.04(0.44, 2.50)	0.57(0.28, 1.19)	1.06(0.41, 2.71)	2.00(0.58, 6.97)	0.29(0.07, 1.18)
Age (36-59years)	1.20(0.50, 2.88)	0.56(0.27, 1.16)	1.03(0.41, 2.57)	2.40(0.70, 8.22)	0.40(0.10, 1.65)
Age (60+)	1.21(0.50, 2.93)	0.53(0.26, 1.11)	1.13(0.45, 2.87)	2.72(0.78, 9.47)	0.45(0.11, 1.87)
Wealth status (Middle)	5.52(4.67, 6.53)	37.50(18.87, 74.52)	3.63(2.96, 4.44)	5.49(4.42, 6.83)	11.74(9.23, 14.94)
Wealth status (Rich)	61.23(45.31,82.74)	1103.69(527.70,2308.39)	53.86(36.24,80.02)	25.75(18.62,35.62)	103.47(74.19,144.30)
Household size (2 to 3)	0.91(0.72, 1.15)	1.10(0.93, 1.31)	0.87(0.70, 1.09)	0.87(0.69, 1.10)	0.97(0.81, 1.16)
Household size (4 to 5)	1.14(0.89, 1.46)	1.09(0.89, 1.32)	0.98(0.75, 1.29)	0.85(0.65, 1.10)	1.02(0.80, 1.31)
Household size (6 to 7)	1.09(0.83, 1.44)	1.10(0.89, 1.37)	0.93(0.68, 1.26)	0.70(0.53, 0.92)	0.98(0.76, 1.28)
Household size (8+)	1.34(1.00, 1.79)	1.10(0.85, 1.42)	1.10(0.78, 1.55)	1.00(0.69, 1.44)	0.99(0.71, 1.37)
No. children U5 (1-2)	0.81(0.71, 0.92)	0.88(0.76, 1.03)	0.83(0.73, 0.95)	0.98(0.85, 1.12)	0.94(0.78, 1.13)
No. children U5 (3+)	0.68(0.56, 0.83)	0.77(0.61, 0.97)	0.75(0.61, 0.93)	1.05(0.75, 1.46)	0.77(0.53, 1.11)

Determinants of healthy housing

Variable	Kenya (2014)	Malawi (2015-2016)	Mali (2012-2013)	Namibia (2013)	Nigeria (2018)
Intercept	0.66(0.36, 1.23)	0.16(0.07, 0.36)	0.79(0.30, 2.07)	0.28(0.09, 0.94)	1.09(0.50, 2.36)
Residence (Urban)	0.48(0.39, 0.58)	0.48(0.38, 0.60)	0.12(0.08, 0.17)	0.02(0.01, 0.04)	0.20(0.16, 0.24)
Gender (Male)	0.94(0.86, 1.03)	0.70(0.64, 0.78)	0.96(0.79, 1.15)	1.05(0.90, 1.24)	0.71(0.63, 0.79)
Age (18-35years)	1.44(0.79, 2.64)	0.59(0.27, 1.27)	0.42(0.16, 1.08)	2.14(0.65, 7.09)	1.01(0.48, 2.14)
Age (36-59years)	1.08(0.59, 1.97)	0.77(0.35, 1.67)	0.41(0.16, 1.05)	2.03(0.62, 6.68)	1.08(0.51, 2.30)
Age (60+)	0.95(0.52, 1.75)	0.85(0.40, 1.83)	0.43(0.16, 1.14)	1.57(0.48, 5.08)	1.11(0.52, 2.37)
Wealth status (Middle)	4.85(4.32, 5.45)	10.34(9.10, 11.75)	6.44(5.39, 7.68)	28.97(21.81, 38.48)	17.61(15.23, 20.37)
Wealth status (Rich)	80.95(64.91,100.95)	112.39(95.83,131.81)	60.96(44.26,83.95)	2812.20(1634.76,4837.68)	190.17(136.05,265.81)
Household size (2 to 3)	0.73(0.65, 0.83)	1.02(0.83, 1.25)	0.91(0.65, 1.26)	0.66(0.53, 0.83)	0.70(0.61, 0.81)
Household size (4 to 5)	0.56(0.49, 0.64)	1.10(0.89, 1.36)	1.14(0.81, 1.60)	0.51(0.40, 0.66)	0.64(0.55, 0.74)
Household size (6 to 7)	0.51(0.44, 0.60)	1.15(0.91, 1.44)	1.15(0.81, 1.63)	0.44(0.32, 0.61)	0.60(0.50, 0.71)
Household size (8+)	0.53(0.44, 0.65)	1.06(0.82, 1.38)	1.11(0.77, 1.59)	0.34(0.24, 0.48)	0.57(0.46, 0.71)
No. children U5 (1-2)	0.81(0.74, 0.88)	0.88(0.78, 0.98)	0.98(0.85, 1.12)	0.84(0.70, 1.02)	0.97(0.88, 1.07)
No. children U5 (3+)	0.55(0.45, 0.67)	1.15(0.85, 1.58)	0.97(0.77, 1.23)	0.90(0.62, 1.31)	1.01(0.87, 1.18)

DETERMINANTS OF HEALTHY HOUSING

Variable	Senegal (2017)	South Africa (2016)	Tanzania (2015-2016)	Uganda (2016)	Zambia (2013-2014)
Intercept	0.43(0.06, 3.27)	1.81(0.81, 4.05)	0.20(0.03, 1.52)	0.57(0.34, 0.95)	0.34(0.09, 1.24)
Residence (Urban)	0.09(0.06, 0.13)	0.74(0.49, 1.12)	0.10(0.07, 0.14)	0.29(0.22, 0.38)	0.06(0.05, 0.09)
Gender (Male)	0.62(0.51, 0.74)	0.99(0.84, 1.16)	1.13(0.99, 1.28)	0.88(0.80, 0.97)	0.99(0.88, 1.11)
Age (18-35years)	4.22(0.57, 31.34)	1.57(0.73, 3.36)	0.75(0.10, 5.63)	0.71(0.42, 1.18)	2.10(0.56, 7.79)
Age (36-59years)	4.69(0.64, 34.23)	1.25(0.58, 2.71)	0.81(0.11, 6.07)	0.64(0.38, 1.08)	1.77(0.48, 6.59)
Age (60+)	5.05(0.69, 37.25)	1.18(0.53, 2.66)	0.75(0.10, 5.64)	0.66(0.40, 1.12)	1.68(0.45, 6.27)
Wealth status (Middle)	49.97(35.53, 70.27)	19.01(12.65, 28.58)	7.82(6.52, 9.38)	5.10(4.46, 5.83)	9.12(7.76, 10.71)
Wealth status (Rich)	1854.02(868.44,3958.08)	91.33(54.02,154.39)	202.14(139.70,292.49)	87.50(69.98,109.41)	244.56(181.74,329.09)
Household size (2 to 3)	0.93(0.61, 1.41)	0.98(0.80, 1.20)	1.21(0.98, 1.48)	0.88(0.75, 1.03)	0.87(0.70, 1.08)
Household size (4 to 5)	0.71(0.47, 1.07)	0.99(0.76, 1.29)	1.39(1.10, 1.77)	0.79(0.67, 0.94)	0.86(0.69, 1.08)
Household size (6 to 7)	0.80(0.51, 1.25)	0.89(0.63, 1.27)	1.67(1.27, 2.19)	0.91(0.76, 1.09)	0.79(0.62, 1.02)
Household size (8+)	1.13(0.73, 1.75)	0.93(0.64, 1.35)	1.54(1.14, 2.06)	0.99(0.80, 1.24)	0.96(0.74, 1.24)
No. children U5 (1-2)	0.82(0.67, 1.00)	0.88(0.72, 1.08)	0.90(0.78, 1.04)	0.95(0.86, 1.06)	0.91(0.79, 1.04)
No. children U5 (3+)	0.91(0.71, 1.16)	0.44(0.27, 0.71)	0.78(0.59, 1.03)	0.99(0.82, 1.20)	0.96(0.77, 1.21)

DISCUSSION AND CONCLUSION

- Understanding both the characteristics of healthy housing in urban and rural Africa remains an important evidence generation agenda, more so in the context of Covid-19 pandemic that places housing at the Center of responses globally and the billion people living in urban slums susceptible to infection linked to inadequate housing and related services .
- In terms of definition, measuring healthy housing remains a challenge that is exacerbated by lack of data across contexts and countries in the SSA region.
- We created a healthy housing index score using 8 variables relating to housing structure and condition and factor analysis using DHS data for 15 selected countries. The robustness of the index was established with tests for internal consistency, reliability, validity, sampling adequacy, sphericity, etc.
- In terms of profiles and determinants socioeconomic advantage is highly correlated with healthy housing, with advantages identified among richest households.
- While the urban advantage was observed for majority of the countries, Ethiopia, Ghana, Nigeria, Senegal, and South Africa had more than 60% of healthy housing in rural areas. .

Discussion and Conclusion

- While our data interpretation is ongoing, we can already infer from these results that healthy housing gap remains high across most sub-Saharan countries, especially in urban areas of the largest countries.

- Amid the COVID 19 pandemic where many people are confined or compelled to work from home, the health impact of unhealthy housing must be critically assessed and that is the next stage of our analysis

- Pulling data on child intestinal parasites, breathing, cough, fever, and diarrhea for few Countries and asking the question which of the health outcomes is ideal for our objectives?

- **Loading**……..