

**Supporting Information for:**  
**Structural Characteristics of Household Carbon Footprint  
in Aging Society**

*Ying Long<sup>1</sup>, Jiahao Feng<sup>1</sup>, Aolong Sun<sup>1</sup>, Rui Wang<sup>2\*</sup> and Yafei Wang<sup>1</sup>*

*<sup>1</sup> School of Statistics, Beijing Normal University, Beijing, 100875, China*

*<sup>2</sup> School of Statistics and Mathematics, Shanghai Lixin University of Accounting and Finance,  
Shanghai, 201209, China*

*\* Corresponding author.*

*Email: 18709483691@163.com*

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## Additional Details on Results

**Table S1. The coordination matrix of consumer products and industrial sectors.**

Industrial sector	Food	Clothing	Residence	Appliances	Transport	Education	Healthcare	Others
Agriculture, forestry, animal husbandry and fishery	1	0	0	0	0	0	0	0
Mining and washing of coal	0	0	1	0	0	0	0	0
Extraction of petroleum and natural gas	0	0	1	0	0	0	0	0
Mining and processing of metal ores	0	0	0	0	0	0	0	0
Mining and processing of nonmetal and other ores	0	0	0	0	0	0	0	0
Food and tobacco processing	1	0	0	0	0	0	0	0
Textile industry	0	1	0	1	0	0	0	0
Manufacture of leather, fur, feather and related products	0	1	0	0	0	0	0	0
Processing of timber and furniture	0	0	0	1	0	0	0	0
Manufacture of paper, printing and articles for culture, education and sport activity	0	0	0	1	0	1	0	0
Processing of petroleum, coking, processing of nuclear fuel	0	0	1	0	1	0	0	0
Manufacture of chemical products	0	0	0	1	0	0	0	0
Manufacture of non-metallic mineral products	0	0	0	1	0	0	0	0
Smelting and processing of metals	0	0	0	0	0	0	0	0
Manufacture of metal products	0	0	0	1	0	0	0	0
Manufacture of general purpose machinery	0	0	0	0	0	0	0	0
Manufacture of special purpose machinery	0	0	0	0	0	0	1	0
Manufacture of transport equipment	0	0	0	0	1	0	0	0

Manufacture of electrical machinery and equipment	0	0	0	1	0	0	0	0
Manufacture of communication equipment, computers and other electronic equipment	0	0	0	0	1	0	0	0
Manufacture of measuring instruments	0	0	0	0	0	0	0	1
Other manufacturing and waste resources	0	0	0	1	0	0	0	1
Repair of metal products, machinery and equipment	0	0	0	0	0	0	0	1
Production and distribution of electric power and heat power	0	0	1	0	0	0	0	0
Production and distribution of gas	0	0	1	0	0	0	0	0
Production and distribution of tap water	0	0	1	0	0	0	0	0
Construction	0	0	0	0	0	0	0	0
Wholesale and retail trades	1	0	1	1	0	1	1	1
Transport, storage, and postal services	0	0	0	0	1	0	0	0
Accommodation and catering	1	0	0	0	0	0	0	1
Information transfer, software and information technology services	0	0	0	0	1	0	0	0
Finance	0	0	0	0	0	0	1	1
Real estate	0	0	1	0	0	0	0	0
Leasing and commercial services	0	0	1	1	0	0	0	1
Scientific research	0	0	0	0	0	0	0	1
Polytechnic services	0	0	0	0	0	0	0	1
Administration of water, environment, and public facilities	0	0	0	0	0	0	0	1
Resident, repair and other services	0	0	0	1	0	0	0	1
Education	0	0	0	0	0	1	0	0
Health care and social work	0	0	0	0	0	0	1	1
Culture, sports, and entertainment	0	0	0	0	0	0	0	0
Public administration, social insurance, and social organizations	0	0	0	0	0	1	0	1

**Table S2. 7 regions and their provinces and cities.**

<b>Region</b>	<b>Provinces and cities</b>
North	Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia
East	Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi
Northeast	Liaoning, Jilin, Heilongjiang
Central	Hubei, Hunan, Henan, Jiangxi
South	Guangdong, Guangxi, Hainan
Southwest	Sichuan, Chongqing, Guizhou, Yunnan
Northwest	Shaanxi, Gansu, Xinjiang, Qinghai, Ningxia

**Table S3. Top five carbon-emission paths for the elderly by regions.**

Region	Paths	%
Beijing	Beijing production and distribution of electric power and heat power	13.07%
	Beijing production and distribution of electric power and heat power→Beijing production and distribution of electric power and heat power	3.68%
	Inner Mongolia production and distribution of electric power and heat power→Beijing production and distribution of electric power and heat power	1.75%
	Beijing wholesale and retail trades	1.54%
	Shandong production and distribution of electric power and heat power→Beijing production and distribution of electric power and heat power	1.33%
Tianjin	Tianjin production and distribution of electric power and heat power	49.06%
	Tianjin production and distribution of electric power and heat power→Tianjin production and distribution of electric power and heat power	13.05%
	Tianjin production and distribution of electric power and heat power→Tianjin production and distribution of electric power and heat power→Tianjin production and distribution of electric power and heat power	3.47%
	Tianjin wholesale and retail trades	2.60%
	Tianjin production and distribution of electric power and heat power→Tianjin accommodation and catering	1.59%
Hebei	Hebei production and distribution of electric power and heat power	59.08%
	Hebei production and distribution of electric power and heat power→Hebei production and distribution of electric power and heat power	9.42%
	Hebei production and distribution of electric power and heat power→Hebei production and distribution of electric power and heat power→Hebei production and distribution of electric power and heat power	1.50%
	Hebei processing of petroleum, coking, processing of nuclear fuel	1.36%
	Hebei wholesale and retail trades	1.08%
Shanxi	Shanxi production and distribution of electric power and heat power	61.53%
	Shanxi production and distribution of electric power and heat power→Shanxi production and distribution of electric power and heat power	7.63%
	Shanxi processing of petroleum, coking, processing of nuclear fuel	4.92%
	Shanxi production and distribution of electric power and heat power→Shanxi accommodation and catering	2.93%
	Shanxi wholesale and retail trades	1.53%
Inner Mongolia	Inner Mongolia production and distribution of electric power and heat power	69.52%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia production and distribution of electric power and heat power	11.94%

Liaoning	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia production and distribution of electric power and heat power	2.05%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia accommodation and catering	2.05%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia wholesale and retail trades	1.08%
	Liaoning production and distribution of electric power and heat power	48.12%
	Liaoning production and distribution of electric power and heat power→Liaoning production and distribution of electric power and heat power	9.87%
	Liaoning production and distribution of electric power and heat power→Liaoning production and distribution of electric power and heat power→Liaoning production and distribution of electric power and heat power	2.02%
	Liaoning agriculture, forestry, animal husbandry and fishery	1.90%
	Liaoning transport, storage, and postal services	1.80%
Jilin	Jilin production and distribution of electric power and heat power	77.58%
	Jilin production and distribution of electric power and heat power→Jilin wholesale and retail trades	1.65%
	Jilin production and distribution of electric power and heat power→Jilin production and distribution of electric power and heat power	1.61%
	Jilin food and tobacco processing	1.50%
Heilongjiang	Jilin production and distribution of electric power and heat power→Jilin accommodation and catering	0.96%
	Heilongjiang production and distribution of electric power and heat power	51.88%
	Heilongjiang production and distribution of electric power and heat power→Heilongjiang production and distribution of electric power and heat power	4.84%
	Heilongjiang wholesale and retail trades	4.74%
	Heilongjiang agriculture, forestry, animal husbandry and fishery	3.59%
Shanghai	Heilongjiang transport, storage, and postal services	1.69%
	Shanghai production and distribution of electric power and heat power	36.09%
	Shanghai production and distribution of electric power and heat power→Shanghai production and distribution of electric power and heat power	5.37%
	Shanghai wholesale and retail trades	4.91%
Jiangsu	Shanghai transport, storage, and postal services	3.17%
	Shanghai production and distribution of electric power and heat power→Shanghai accommodation and catering	2.45%
	Jiangsu production and distribution of electric power and heat power	42.44%
	Jiangsu production and distribution of electric power and heat power→Jiangsu production and distribution of electric power and heat power	10.87%
	Jiangsu production and distribution of electric power and heat power→Jiangsu production and distribution of electric power and heat power→Jiangsu production and distribution of electric power and heat power	2.78%

Zhejiang	Jiangsu food and tobacco processing	2.27%
	Jiangsu production and distribution of electric power and heat power→Jiangsu accommodation and catering	2.03%
	Zhejiang production and distribution of electric power and heat power	36.74%
	Zhejiang production and distribution of electric power and heat power→Zhejiang production and distribution of electric power and heat power	11.73%
	Zhejiang production and distribution of electric power and heat power→Zhejiang production and distribution of electric power and heat power→Zhejiang production and distribution of electric power and heat power	3.75%
	Zhejiang agriculture, forestry, animal husbandry and fishery	3.48%
Anhui	Zhejiang production and distribution of electric power and heat power→Zhejiang accommodation and catering	1.94%
	Anhui production and distribution of electric power and heat power	62.73%
	Anhui production and distribution of electric power and heat power→Anhui production and distribution of electric power and heat power	8.24%
	Anhui production and distribution of electric power and heat power→Anhui accommodation and catering	1.14%
Fujian	Anhui production and distribution of electric power and heat power→Anhui production and distribution of electric power and heat power→Anhui production and distribution of electric power and heat power	1.08%
	Anhui production and distribution of electric power and heat power→Anhui wholesale and retail trades	1.06%
	Fujian production and distribution of electric power and heat power	42.40%
	Fujian production and distribution of electric power and heat power→Fujian production and distribution of electric power and heat power	14.70%
	Fujian production and distribution of electric power and heat power→Fujian production and distribution of electric power and heat power→Fujian production and distribution of electric power and heat power	5.10%
	Fujian transport, storage, and postal services	2.96%
Jiangxi	Fujian production and distribution of electric power and heat power→Fujian accommodation and catering	1.92%
	Jiangxi production and distribution of electric power and heat power	51.68%
	Jiangxi production and distribution of electric power and heat power→Jiangxi production and distribution of electric power and heat power	6.88%
	Jiangxi transport, storage, and postal services	1.70%
	Jiangxi wholesale and retail trades	1.46%
Shandong	Jiangxi production and distribution of electric power and heat power→Jiangxi wholesale and retail trades	1.36%
	Shandong production and distribution of electric power and heat power	34.38%
	Shandong production and distribution of electric power and heat power→Shandong production and distribution of electric power and heat power	6.88%
	Shandong food and tobacco processing	5.23%
	Shandong production and distribution of electric power and heat power→Shandong food and tobacco processing	2.92%
	Shandong transport, storage, and postal services	1.59%



Henan	Henan production and distribution of electric power and heat power	44.64%
	Henan production and distribution of electric power and heat power→Henan production and distribution of electric power and heat power	6.83%
	Henan production and distribution of electric power and heat power→Henan food and tobacco processing	2.42%
	Henan transport, storage, and postal services	1.43%
	Henan production and distribution of electric power and heat power→Henan accommodation and catering	1.17%
Hubei	Hubei production and distribution of electric power and heat power	51.89%
	Hubei production and distribution of electric power and heat power→Hubei production and distribution of electric power and heat power	6.85%
	Hubei food and tobacco processing	3.05%
	Hubei transport, storage, and postal services	2.54%
Hunan	Hubei wholesale and retail trades	2.06%
	Hunan production and distribution of electric power and heat power	35.51%
	Hunan wholesale and retail trades	7.39%
	Hunan production and distribution of electric power and heat power→Hunan production and distribution of electric power and heat power	5.21%
	Hunan transport, storage, and postal services	3.63%
Guangdong	Hunan agriculture, forestry, animal husbandry and fishery	3.46%
	Guangdong production and distribution of electric power and heat power	36.56%
	Guangdong production and distribution of electric power and heat power→Guangdong production and distribution of electric power and heat power	11.33%
	Guangdong production and distribution of electric power and heat power→Guangdong production and distribution of electric power and heat power→Guangdong production and distribution of electric power and heat power	3.51%
	Guangdong wholesale and retail trades	2.11%
Guangxi	Guangdong production and distribution of electric power and heat power→Guangdong accommodation and catering	1.85%
	Guangxi production and distribution of electric power and heat power	46.04%
	Guangxi production and distribution of electric power and heat power→Guangxi production and distribution of electric power and heat power	9.62%
	Guangxi transport, storage, and postal services	3.94%
	Guangxi food and tobacco processing	3.87%
Hainan	Guangxi processing of petroleum, coking, processing of nuclear fuel	2.68%
	Hainan production and distribution of electric power and heat power	44.50%
	Hainan processing of petroleum, coking, processing of nuclear fuel	4.84%

Chongqing	Hainan production and distribution of electric power and heat power→Hainan processing of petroleum, coking, processing of nuclear fuel	4.47%
	Hainan transport, storage, and postal services	4.11%
	Hainan agriculture, forestry, animal husbandry and fishery	3.28%
	Chongqing production and distribution of electric power and heat power	25.05%
	Chongqing agriculture, forestry, animal husbandry and fishery	4.14%
	Chongqing production and distribution of electric power and heat power→Chongqing production and distribution of electric power and heat power	3.78%
	Chongqing wholesale and retail trades	3.21%
Sichuan	Chongqing transport, storage, and postal services	2.80%
	Sichuan food and tobacco processing	16.49%
	Sichuan production and distribution of electric power and heat power	9.77%
	Sichuan wholesale and retail trades	7.51%
Guizhou	Sichuan transport, storage, and postal services	6.00%
	Sichuan manufacture of leather, fur, feather and related products	2.33%
	Guizhou production and distribution of electric power and heat power	47.14%
	Guizhou production and distribution of electric power and heat power→Guizhou production and distribution of electric power and heat power	14.95%
	Guizhou production and distribution of electric power and heat power→Guizhou production and distribution of electric power and heat power	4.74%
Yunnan	Guizhou wholesale and retail trades	3.20%
	Guizhou transport, storage, and postal services	2.67%
	Yunnan production and distribution of electric power and heat power	41.44%
	Yunnan production and distribution of electric power and heat power→Yunnan production and distribution of electric power and heat power	7.57%
	Yunnan transport, storage, and postal services	5.27%
Shaanxi	Yunnan processing of petroleum, coking, processing of nuclear fuel	3.15%
	Yunnan mining and washing of coal	2.47%
	Shaanxi production and distribution of electric power and heat power	63.70%
	Shaanxi production and distribution of electric power and heat power→Shaanxi production and distribution of electric power and heat power	3.38%
	Shaanxi processing of petroleum, coking, processing of nuclear fuel	1.82%
	Shaanxi transport, storage, and postal services	1.28%

Gansu	Shaanxi production and distribution of gas	1.26%
	Gansu production and distribution of electric power and heat power	60.79%
	Gansu production and distribution of electric power and heat power→Gansu production and distribution of electric power and heat power	10.09%
	Gansu food and tobacco processing	3.31%
	Gansu processing of petroleum, coking, processing of nuclear fuel	1.96%
	Gansu production and distribution of electric power and heat power→Gansu production and distribution of electric power and heat power→Gansu production and distribution of electric power and heat power	1.67%
Qinghai	Qinghai production and distribution of electric power and heat power	41.54%
	Qinghai production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power	11.33%
	Qinghai manufacture of chemical products	3.39%
	Qinghai production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power	3.09%
	Anhui production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power	2.25%
Ningxia	Ningxia production and distribution of electric power and heat power	58.49%
	Ningxia production and distribution of electric power and heat power→Ningxia production and distribution of electric power and heat power	16.34%
	Ningxia production and distribution of electric power and heat power→Ningxia production and distribution of electric power and heat power→Ningxia production and distribution of electric power and heat power	4.56%
	Ningxia processing of petroleum, coking, processing of nuclear fuel	3.02%
	Ningxia production and distribution of electric power and heat power→Ningxia accommodation and catering	1.97%
Xinjiang	Xinjiang production and distribution of electric power and heat power	72.46%
	Xinjiang production and distribution of electric power and heat power→Xinjiang production and distribution of electric power and heat power	8.69%
	Xinjiang processing of petroleum, coking, processing of nuclear fuel	2.19%
	Xinjiang production and distribution of electric power and heat power→Xinjiang production and distribution of electric power and heat power→Xinjiang production and distribution of electric power and heat power	1.04%
	Xinjiang production and distribution of electric power and heat power→Xinjiang food and tobacco processing	0.86%

## Major carbon emission pathways for young people

There is no significant difference in the main carbon-emission pathways between age groups (**Table S4** and **Table S5**). For the children group and the working group, most pathways are concentrated in the zeroth and first stages. In terms of the industrial sector, *Production and distribution of electric power and heat power*, *Wholesale and retail trades*, *Accommodation and catering*, *Food and tobacco processing*, and *Transport, storage, and postal services* are also major contributors to carbon emissions. The reason for the similarity of the carbon emission paths of older and younger people is the homogeneity of their consumption structures. For all age groups, food and housing expenditure account for more than 50% of the total consumption. Thus, industrial sectors related to housing energy use and food production significantly influence carbon emissions across all age groups, resulting in the same carbon emission paths. Although young people favor clothing consumption, the *Manufacture of leather, fur, feather and related products* sector appears in the top five pathways only in Sichuan, with emission shares of 3.05% (for the children group) and 2.93% (for the working group), respectively.

**Table S4. Top five carbon-emission paths for the children group by regions.**

Region	Paths	Percentage
Beijing	Beijing production and distribution of electric power and heat power	13.08%
	Beijing production and distribution of electric power and heat power→Beijing production and distribution of electric power and heat power	3.69%
	Inner Mongolia production and distribution of electric power and heat power→Beijing production and distribution of electric power and heat power	1.75%
	Beijing wholesale and retail trades	1.51%
	Shandong production and distribution of electric power and heat power→Beijing production and distribution of electric power and heat power	1.33%
Tianjin	Tianjin production and distribution of electric power and heat power	49.56%
	Tianjin production and distribution of electric power and heat power→Tianjin production and distribution of electric power and heat power	13.18%
	Tianjin production and distribution of electric power and heat power→Tianjin production and distribution of electric power and heat power→Tianjin production and distribution of electric power and heat power	3.50%
	Tianjin wholesale and retail trades	2.53%
	Tianjin production and distribution of electric power and heat power→Tianjin accommodation and catering	1.43%
Hebei	Hebei production and distribution of electric power and heat power	59.42%
	Hebei production and distribution of electric power and heat power→Hebei production and distribution of electric power and heat power	9.47%
	Hebei production and distribution of electric power and heat power→Hebei production and distribution of electric power and heat power→Hebei production and distribution of electric power and heat power	1.51%
	Hebei processing of petroleum, coking, processing of nuclear fuel	1.37%
	Hebei wholesale and retail trades	1.06%
Shanxi	Shanxi production and distribution of electric power and heat power	57.63%
	Shanxi production and distribution of electric power and heat power→Shanxi production and distribution of electric power and heat power	7.15%
	Shanxi processing of petroleum, coking, processing of nuclear fuel	5.65%
	Shanxi production and distribution of electric power and heat power→Shanxi accommodation and catering	3.22%
	Shanxi wholesale and retail trades	1.71%

Inner Mongolia	Inner Mongolia production and distribution of electric power and heat power	66.59%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia production and distribution of electric power and heat power	11.43%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia accommodation and catering	2.45%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia production and distribution of electric power and heat power	1.96%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia wholesale and retail trades	1.31%
Liaoning	Liaoning production and distribution of electric power and heat power	47.92%
	Liaoning production and distribution of electric power and heat power→Liaoning production and distribution of electric power and heat power	9.83%
	Liaoning production and distribution of electric power and heat power→Liaoning production and distribution of electric power and heat power→Liaoning production and distribution of electric power and heat power	2.02%
	Liaoning agriculture, forestry, animal husbandry and fishery	1.85%
	Liaoning production and distribution of electric power and heat power→Liaoning food and tobacco processing	1.75%
Jilin	Jilin production and distribution of electric power and heat power	77.36%
	Jilin production and distribution of electric power and heat power→Jilin wholesale and retail trades	1.69%
	Jilin production and distribution of electric power and heat power→Jilin production and distribution of electric power and heat power	1.61%
	Jilin food and tobacco processing	1.46%
	Jilin production and distribution of electric power and heat power→Jilin accommodation and catering	0.93%
Heilongjiang	Heilongjiang production and distribution of electric power and heat power	51.33%
	Heilongjiang wholesale and retail trades	5.10%
	Heilongjiang production and distribution of electric power and heat power→Heilongjiang production and distribution of electric power and heat power	4.78%
	Heilongjiang agriculture, forestry, animal husbandry and fishery	3.51%
	Heilongjiang transport, storage, and postal services	1.65%
Shanghai	Shanghai production and distribution of electric power and heat power	32.53%
	Shanghai wholesale and retail trades	5.18%
	Shanghai production and distribution of electric power and heat power→Shanghai production and distribution of electric power and heat power	4.84%
	Shanghai transport, storage, and postal services	3.56%

Jiangsu	Shanghai production and distribution of electric power and heat power→Shanghai accommodation and catering	2.52%
	Jiangsu production and distribution of electric power and heat power	37.97%
	Jiangsu production and distribution of electric power and heat power→Jiangsu production and distribution of electric power and heat power	9.72%
	Jiangsu production and distribution of electric power and heat power→Jiangsu production and distribution of electric power and heat power→Jiangsu production and distribution of electric power and heat power	2.49%
	Jiangsu food and tobacco processing	2.32%
Zhejiang	Jiangsu production and distribution of electric power and heat power→Jiangsu accommodation and catering	2.10%
	Zhejiang production and distribution of electric power and heat power	33.08%
	Zhejiang production and distribution of electric power and heat power→Zhejiang production and distribution of electric power and heat power	10.57%
	Zhejiang agriculture, forestry, animal husbandry and fishery	3.55%
	Zhejiang production and distribution of electric power and heat power→Zhejiang production and distribution of electric power and heat power→Zhejiang production and distribution of electric power and heat power	3.37%
Anhui	Zhejiang production and distribution of electric power and heat power→Zhejiang accommodation and catering	2.00%
	Anhui production and distribution of electric power and heat power	60.85%
	Anhui production and distribution of electric power and heat power→Anhui production and distribution of electric power and heat power	7.99%
	Anhui transport, storage, and postal services	1.28%
	Anhui production and distribution of electric power and heat power→Anhui accommodation and catering	1.20%
Fujian	Anhui production and distribution of electric power and heat power→Anhui wholesale and retail trades	1.10%
	Fujian production and distribution of electric power and heat power	42.35%
	Fujian production and distribution of electric power and heat power→Fujian production and distribution of electric power and heat power	14.68%
	Fujian production and distribution of electric power and heat power→Fujian production and distribution of electric power and heat power→Fujian production and distribution of electric power and heat power	5.09%
	Fujian transport, storage, and postal services	3.34%
Jiangxi	Fujian production and distribution of electric power and heat power→Fujian accommodation and catering	1.77%
	Jiangxi production and distribution of electric power and heat power	49.51%
	Jiangxi production and distribution of electric power and heat power→Jiangxi production and distribution of electric power and heat power	6.59%

	Jiangxi transport, storage, and postal services	2.08%
	Jiangxi wholesale and retail trades	1.48%
	Jiangxi production and distribution of electric power and heat power→Jiangxi wholesale and retail trades	1.38%
Shandong	Shandong production and distribution of electric power and heat power	32.50%
	Shandong production and distribution of electric power and heat power→Shandong production and distribution of electric power and heat power	6.50%
	Shandong food and tobacco processing	4.97%
	Shandong production and distribution of electric power and heat power→Shandong food and tobacco processing	2.77%
	Shandong transport, storage, and postal services	1.82%
Henan	Henan production and distribution of electric power and heat power	42.23%
	Henan production and distribution of electric power and heat power→Henan production and distribution of electric power and heat power	6.46%
	Henan production and distribution of electric power and heat power→Henan food and tobacco processing	2.45%
	Henan transport, storage, and postal services	1.78%
	Henan production and distribution of electric power and heat power→Henan accommodation and catering	1.20%
Hubei	Hubei production and distribution of electric power and heat power	48.66%
	Hubei production and distribution of electric power and heat power→Hubei production and distribution of electric power and heat power	6.42%
	Hubei transport, storage, and postal services	3.18%
	Hubei food and tobacco processing	3.05%
	Hubei wholesale and retail trades	2.18%
Hunan	Hunan production and distribution of electric power and heat power	32.21%
	Hunan wholesale and retail trades	7.86%
	Hunan production and distribution of electric power and heat power→Hunan production and distribution of electric power and heat power	4.72%
	Hunan transport, storage, and postal services	4.36%
	Hunan agriculture, forestry, animal husbandry and fishery	3.53%
Guangdong	Guangdong production and distribution of electric power and heat power	36.50%
	Guangdong production and distribution of electric power and heat power→Guangdong production and distribution of electric power and heat power	11.31%



Guangxi	Guangdong production and distribution of electric power and heat power→Guangdong production and distribution of electric power and heat power→Guangdong production and distribution of electric power and heat power	3.51%
	Guangdong wholesale and retail trades	2.07%
	Guangdong production and distribution of electric power and heat power→Guangdong accommodation and catering	1.72%
	Guangxi production and distribution of electric power and heat power	43.83%
	Guangxi production and distribution of electric power and heat power→Guangxi production and distribution of electric power and heat power	9.16%
	Guangxi transport, storage, and postal services	4.78%
	Guangxi food and tobacco processing	3.88%
Hainan	Guangxi processing of petroleum, coking, processing of nuclear fuel	2.79%
	Hainan production and distribution of electric power and heat power	43.89%
	Hainan processing of petroleum, coking, processing of nuclear fuel	5.07%
	Hainan production and distribution of electric power and heat power→Hainan processing of petroleum, coking, processing of nuclear fuel	4.68%
Chongqing	Hainan transport, storage, and postal services	4.61%
	Hainan agriculture, forestry, animal husbandry and fishery	3.04%
	Chongqing production and distribution of electric power and heat power	22.86%
	Chongqing agriculture, forestry, animal husbandry and fishery	4.16%
	Chongqing production and distribution of electric power and heat power→Chongqing production and distribution of electric power and heat power	3.45%
Sichuan	Chongqing transport, storage, and postal services	3.25%
	Chongqing wholesale and retail trades	3.24%
	Sichuan food and tobacco processing	15.14%
	Sichuan production and distribution of electric power and heat power	9.16%
	Sichuan wholesale and retail trades	7.28%
	Sichuan transport, storage, and postal services	6.56%
Guizhou	Sichuan manufacture of leather, fur, feather and related products	3.05%
	Guizhou production and distribution of electric power and heat power	45.51%
	Guizhou production and distribution of electric power and heat power→Guizhou production and distribution of electric power and heat power	14.44%

	Guizhou production and distribution of electric power and heat power→Guizhou production and distribution of electric power and heat power→Guizhou production and distribution of electric power and heat power	4.58%
	Guizhou wholesale and retail trades	3.41%
	Guizhou transport, storage, and postal services	3.24%
Yunnan	Yunnan production and distribution of electric power and heat power	38.98%
	Yunnan production and distribution of electric power and heat power→Yunnan production and distribution of electric power and heat power	7.12%
	Yunnan transport, storage, and postal services	6.47%
	Yunnan processing of petroleum, coking, processing of nuclear fuel	3.25%
	Yunnan wholesale and retail trades	2.38%
Shaanxi	shaanxi production and distribution of electric power and heat power	60.78%
	shaanxi production and distribution of electric power and heat power→shaanxi production and distribution of electric power and heat power	3.22%
	shaanxi processing of petroleum, coking, processing of nuclear fuel	2.06%
	shaanxi transport, storage, and postal services	1.77%
	shaanxi production and distribution of gas	1.20%
Gansu	Gansu production and distribution of electric power and heat power	58.18%
	Gansu production and distribution of electric power and heat power→Gansu production and distribution of electric power and heat power	9.65%
	Gansu food and tobacco processing	3.67%
	Gansu processing of petroleum, coking, processing of nuclear fuel	2.11%
	Gansu transport, storage, and postal services	2.08%
Qinghai	Qinghai production and distribution of electric power and heat power	38.76%
	Qinghai production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power	10.57%
	Qinghai manufacture of chemical products	4.62%
	Qinghai production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power	2.88%
	Qinghai transport, storage, and postal services	2.47%
Ningxia	Ningxia production and distribution of electric power and heat power	56.64%

Xinjiang	Ningxia production and distribution of electric power and heat power→Ningxia production and distribution of electric power and heat power	15.82%
	Ningxia production and distribution of electric power and heat power→Ningxia production and distribution of electric power and heat power→Ningxia production and distribution of electric power and heat power	4.42%
	Ningxia processing of petroleum, coking, processing of nuclear fuel	3.23%
	Ningxia production and distribution of electric power and heat power→Ningxia accommodation and catering	2.21%
	Xinjiang production and distribution of electric power and heat power	70.08%
	Xinjiang production and distribution of electric power and heat power→Xinjiang production and distribution of electric power and heat power	8.41%
	Xinjiang processing of petroleum, coking, processing of nuclear fuel	2.28%
	Xinjiang manufacture of chemical products	1.22%
	Xinjiang production and distribution of electric power and heat power→Xinjiang production and distribution of electric power and heat power→Xinjiang production and distribution of electric power and heat power	1.01%

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**Table S5. Top five carbon-emission paths for the working group by regions.**

Region	Paths	Percentage
Beijing	Beijing production and distribution of electric power and heat power	11.87%
	Beijing production and distribution of electric power and heat power→Beijing production and distribution of electric power and heat power	3.35%
	Beijing transport, storage, and postal services	1.81%
	Inner Mongolia production and distribution of electric power and heat power→Beijing production and distribution of electric power and heat power	1.59%
	Beijing wholesale and retail trades	1.53%
Tianjin	Tianjin production and distribution of electric power and heat power	46.28%
	Tianjin production and distribution of electric power and heat power→Tianjin production and distribution of electric power and heat power	12.31%
	Tianjin production and distribution of electric power and heat power→Tianjin production and distribution of electric power and heat power→Tianjin production and distribution of electric power and heat power	3.27%
	Tianjin wholesale and retail trades	2.62%
	Tianjin production and distribution of electric power and heat power→Tianjin accommodation and catering	1.67%
Hebei	Hebei production and distribution of electric power and heat power	56.30%
	Hebei production and distribution of electric power and heat power→Hebei production and distribution of electric power and heat power	8.97%
	Hebei processing of petroleum, coking, processing of nuclear fuel	1.52%
	Hebei production and distribution of electric power and heat power→Hebei production and distribution of electric power and heat power→Hebei production and distribution of electric power and heat power	1.43%
	Hebei wholesale and retail trades	1.09%
Shanxi	Shanxi production and distribution of electric power and heat power	58.79%
	Shanxi production and distribution of electric power and heat power→Shanxi production and distribution of electric power and heat power	7.29%
	Shanxi processing of petroleum, coking, processing of nuclear fuel	5.89%
	Shanxi production and distribution of electric power and heat power→Shanxi accommodation and catering	2.91%
	Shanxi transport, storage, and postal services	1.66%

Inner Mongolia	Inner Mongolia production and distribution of electric power and heat power	66.74%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia production and distribution of electric power and heat power	11.46%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia accommodation and catering	2.31%
	Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia production and distribution of electric power and heat power→Inner Mongolia production and distribution of electric power and heat power	1.97%
	Inner Mongolia processing of petroleum, coking, processing of nuclear fuel	1.21%
Liaoning	Liaoning production and distribution of electric power and heat power	45.46%
	Liaoning production and distribution of electric power and heat power→Liaoning production and distribution of electric power and heat power	9.32%
	Liaoning transport, storage, and postal services	2.83%
	Liaoning production and distribution of electric power and heat power→Liaoning production and distribution of electric power and heat power→Liaoning production and distribution of electric power and heat power	1.91%
	Liaoning agriculture, forestry, animal husbandry and fishery	1.90%
Jilin	Jilin production and distribution of electric power and heat power	75.65%
	Jilin production and distribution of electric power and heat power→Jilin wholesale and retail trades	1.60%
	Jilin production and distribution of electric power and heat power→Jilin production and distribution of electric power and heat power	1.57%
	Jilin food and tobacco processing	1.56%
	Jilin production and distribution of electric power and heat power→Jilin accommodation and catering	1.01%
Heilongjiang	Heilongjiang production and distribution of electric power and heat power	49.99%
	Heilongjiang production and distribution of electric power and heat power→Heilongjiang production and distribution of electric power and heat power	4.66%
	Heilongjiang wholesale and retail trades	4.58%
	Heilongjiang agriculture, forestry, animal husbandry and fishery	3.62%
	Heilongjiang transport, storage, and postal services	2.70%
Shanghai	Shanghai production and distribution of electric power and heat power	33.55%
	Shanghai production and distribution of electric power and heat power→Shanghai production and distribution of electric power and heat power	4.99%
	Shanghai wholesale and retail trades	4.72%
	Shanghai transport, storage, and postal services	4.70%

Jiangsu	Shanghai production and distribution of electric power and heat power→Shanghai accommodation and catering	2.39%
	Jiangsu production and distribution of electric power and heat power	39.45%
	Jiangsu production and distribution of electric power and heat power→Jiangsu production and distribution of electric power and heat power	10.10%
	Jiangsu production and distribution of electric power and heat power→Jiangsu production and distribution of electric power and heat power→Jiangsu production and distribution of electric power and heat power	2.59%
	Jiangsu food and tobacco processing	2.20%
Zhejiang	Jiangsu production and distribution of electric power and heat power→Jiangsu accommodation and catering	1.97%
	Zhejiang production and distribution of electric power and heat power	34.31%
	Zhejiang production and distribution of electric power and heat power→Zhejiang production and distribution of electric power and heat power	10.96%
	Zhejiang production and distribution of electric power and heat power→Zhejiang production and distribution of electric power and heat power→Zhejiang production and distribution of electric power and heat power	3.50%
	Zhejiang agriculture, forestry, animal husbandry and fishery	3.41%
Anhui	Zhejiang production and distribution of electric power and heat power→Zhejiang accommodation and catering	1.90%
	Anhui production and distribution of electric power and heat power	61.36%
	Anhui production and distribution of electric power and heat power→Anhui production and distribution of electric power and heat power	8.06%
	Anhui transport, storage, and postal services	1.44%
	Anhui production and distribution of electric power and heat power→Anhui accommodation and catering	1.13%
Fujian	Anhui production and distribution of electric power and heat power→Anhui production and distribution of electric power and heat power→Anhui production and distribution of electric power and heat power	1.06%
	Fujian production and distribution of electric power and heat power	41.79%
	Fujian production and distribution of electric power and heat power→Fujian production and distribution of electric power and heat power	14.49%
	Fujian production and distribution of electric power and heat power→Fujian production and distribution of electric power and heat power→Fujian production and distribution of electric power and heat power	5.02%
	Fujian transport, storage, and postal services	3.62%
Jiangxi	Fujian production and distribution of electric power and heat power→Fujian accommodation and catering	1.85%
	Jiangxi production and distribution of electric power and heat power	50.05%
	Jiangxi production and distribution of electric power and heat power→Jiangxi production and distribution of electric power and heat power	6.66%

	Jiangxi transport, storage, and postal services	2.35%
	Jiangxi wholesale and retail trades	1.40%
	Jiangxi production and distribution of electric power and heat power→Jiangxi wholesale and retail trades	1.31%
Shandong	Shandong production and distribution of electric power and heat power	31.87%
	Shandong production and distribution of electric power and heat power→Shandong production and distribution of electric power and heat power	6.37%
	Shandong food and tobacco processing	4.74%
	Shandong production and distribution of electric power and heat power→Shandong food and tobacco processing	2.65%
	Shandong transport, storage, and postal services	2.47%
Henan	Henan production and distribution of electric power and heat power	43.20%
	Henan production and distribution of electric power and heat power→Henan production and distribution of electric power and heat power	6.61%
	Henan production and distribution of electric power and heat power→Henan food and tobacco processing	2.33%
	Henan transport, storage, and postal services	1.98%
	Henan production and distribution of electric power and heat power→Henan accommodation and catering	1.14%
Hubei	Hubei production and distribution of electric power and heat power	50.18%
	Hubei production and distribution of electric power and heat power→Hubei production and distribution of electric power and heat power	6.62%
	Hubei transport, storage, and postal services	3.47%
	Hubei food and tobacco processing	2.94%
	Hubei wholesale and retail trades	1.98%
Hunan	Hunan production and distribution of electric power and heat power	33.52%
	Hunan wholesale and retail trades	7.20%
	Hunan transport, storage, and postal services	5.22%
	Hunan production and distribution of electric power and heat power→Hunan production and distribution of electric power and heat power	4.92%
	Hunan agriculture, forestry, animal husbandry and fishery	3.33%
Guangdong	Guangdong production and distribution of electric power and heat power	36.05%
	Guangdong production and distribution of electric power and heat power→Guangdong production and distribution of electric power and heat power	11.17%

Guangxi	Guangdong production and distribution of electric power and heat power→Guangdong production and distribution of electric power and heat power→Guangdong production and distribution of electric power and heat power	3.46%
	Guangdong wholesale and retail trades	2.05%
	Guangdong production and distribution of electric power and heat power→Guangdong accommodation and catering	1.77%
	Guangxi production and distribution of electric power and heat power	44.59%
	Guangxi production and distribution of electric power and heat power→Guangxi production and distribution of electric power and heat power	9.32%
	Guangxi transport, storage, and postal services	5.14%
	Guangxi food and tobacco processing	3.75%
Hainan	Guangxi processing of petroleum, coking, processing of nuclear fuel	2.90%
	Hainan production and distribution of electric power and heat power	43.47%
	Hainan processing of petroleum, coking, processing of nuclear fuel	5.13%
	Hainan transport, storage, and postal services	4.93%
	Hainan production and distribution of electric power and heat power→Hainan processing of petroleum, coking, processing of nuclear fuel	4.73%
Chongqing	Hainan agriculture, forestry, animal husbandry and fishery	3.10%
	Chongqing production and distribution of electric power and heat power	23.05%
	Chongqing agriculture, forestry, animal husbandry and fishery	4.19%
	Chongqing transport, storage, and postal services	3.69%
	Chongqing production and distribution of electric power and heat power→Chongqing production and distribution of electric power and heat power	3.48%
Sichuan	Chongqing wholesale and retail trades	3.10%
	Sichuan food and tobacco processing	15.19%
	Sichuan production and distribution of electric power and heat power	9.38%
	Sichuan transport, storage, and postal services	7.32%
	Sichuan wholesale and retail trades	6.96%
Guizhou	Sichuan manufacture of leather, fur, feather and related products	2.93%
	Guizhou production and distribution of electric power and heat power	46.37%
	Guizhou production and distribution of electric power and heat power→Guizhou production and distribution of electric power and heat power	14.71%



	Guizhou production and distribution of electric power and heat power→Guizhou production and distribution of electric power and heat power→Guizhou production and distribution of electric power and heat power	4.66%
	Guizhou transport, storage, and postal services	3.49%
	Guizhou wholesale and retail trades	3.13%
Yunnan	Yunnan production and distribution of electric power and heat power	39.65%
	Yunnan production and distribution of electric power and heat power→Yunnan production and distribution of electric power and heat power	7.24%
	Yunnan transport, storage, and postal services	6.89%
	Yunnan processing of petroleum, coking, processing of nuclear fuel	3.36%
	Yunnan mining and washing of coal	2.29%
Shaanxi	shaanxi production and distribution of electric power and heat power	62.07%
	shaanxi production and distribution of electric power and heat power→shaanxi production and distribution of electric power and heat power	3.29%
	shaanxi processing of petroleum, coking, processing of nuclear fuel	2.11%
	shaanxi transport, storage, and postal services	1.83%
	shaanxi production and distribution of gas	1.22%
Gansu	Gansu production and distribution of electric power and heat power	58.87%
	Gansu production and distribution of electric power and heat power→Gansu production and distribution of electric power and heat power	9.77%
	Gansu food and tobacco processing	3.33%
	Gansu transport, storage, and postal services	2.31%
	Gansu processing of petroleum, coking, processing of nuclear fuel	2.23%
Qinghai	Qinghai production and distribution of electric power and heat power	39.37%
	Qinghai production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power	10.74%
	Qinghai manufacture of chemical products	4.30%
	Qinghai production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power→Qinghai production and distribution of electric power and heat power	2.93%
	Qinghai transport, storage, and postal services	2.73%
Ningxia	Ningxia production and distribution of electric power and heat power	57.25%

Xinjiang	Ningxia production and distribution of electric power and heat power→Ningxia production and distribution of electric power and heat power	15.99%
	Ningxia production and distribution of electric power and heat power→Ningxia production and distribution of electric power and heat power→Ningxia production and distribution of electric power and heat power	4.47%
	Ningxia processing of petroleum, coking, processing of nuclear fuel	3.31%
	Ningxia production and distribution of electric power and heat power→Ningxia accommodation and catering	2.01%
	Xinjiang production and distribution of electric power and heat power	70.55%
	Xinjiang production and distribution of electric power and heat power→Xinjiang production and distribution of electric power and heat power	8.46%
	Xinjiang processing of petroleum, coking, processing of nuclear fuel	2.38%
	Xinjiang manufacture of chemical products	1.12%
	Xinjiang production and distribution of electric power and heat power→Xinjiang production and distribution of electric power and heat power→Xinjiang production and distribution of electric power and heat power	1.01%

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## **Sensitivity analysis**

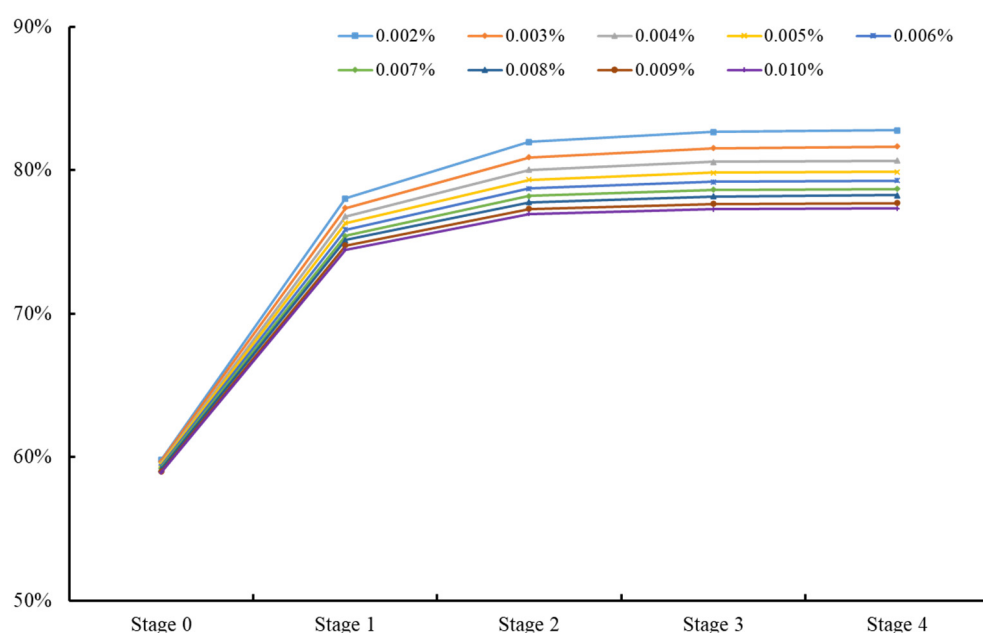
This study used a threshold of 0.005% of the embodied carbon emissions from elderly consumption, filtering out nearly 80% of the overall impact of the first four stages. The results of the SPA depend on the specified thresholds to a large extent. Nevertheless, the threshold selection is usually based on research purposes, which can be somewhat subjective. Therefore, sensitivity analysis of the threshold to quantify these uncertainties and impacts on the results is essential. This paper set a series of thresholds, from 0.002%-0.01%, to discuss the change of results from cumulative carbon emission and the number of paths.

### **Cumulative carbon emission**

Figure S1 shows the cumulative percentage of carbon emissions for the first four stages at different thresholds. As the threshold increases, some low-impact pathways are excluded, resulting in cumulative carbon emissions gradually decreasing. When the threshold is increased from 0.002% to 0.01%, the cumulative carbon emission at Stage 4 is reduced by only 5%. At the threshold of 0.01%, the cumulative carbon emissions of Stage 4 reach 105.73 MtCO<sub>2e</sub>, accounting for 77.35% of the total carbon emissions of older people.

It's worth noting that the change in cumulative carbon emissions is very obvious in Stage 3 and Stage 4. These two stages reflect the interaction between upstream production sectors. Although the paths in the high stages are longer, the carbon emissions are not necessarily significant. As the threshold increases, most pathways in

Stage 3 and Stage 4 are eliminated, causing a substantial reduction in the cumulative percentage of emissions. This means mitigation strategies should focus on the main links in the supply chain and critical production sectors, namely Stage 0, Stage 1, and Stage 2.



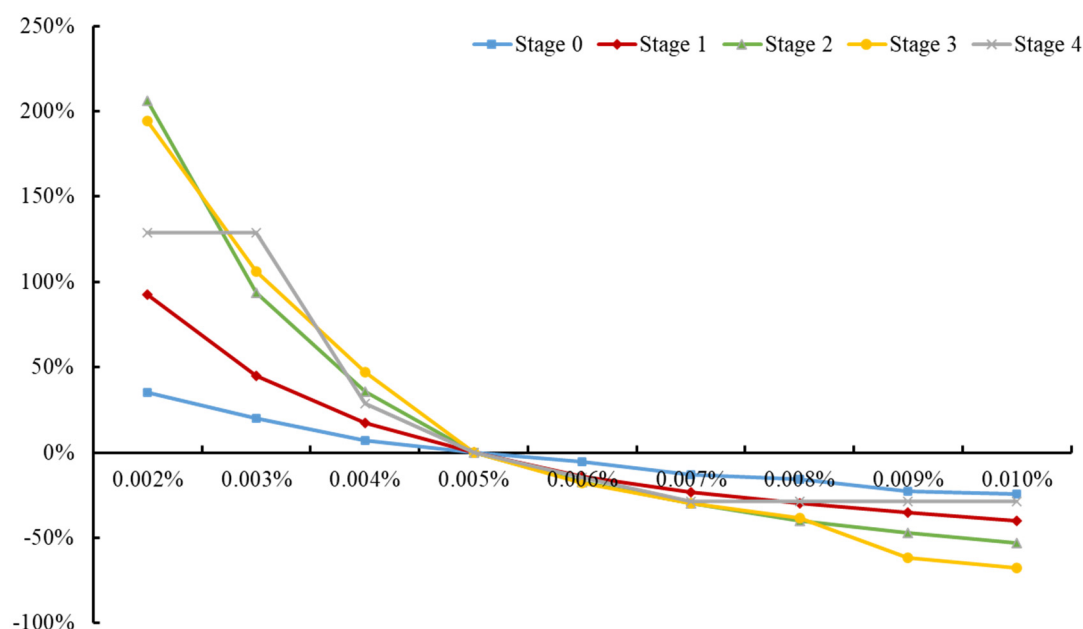
**Figure S1. Change in the percentage of cumulative carbon emissions by stage.**

### The number of paths

The changes in the number of paths for each stage at other thresholds compared to 0.005% are shown in Figure S2. It is clear that when the threshold is lower than 0.005%, the number of selected pathways in each stage is more. The number of paths in the threshold of 0.002% is twice as more as in the standard case. In contrast, the number of pathways at a threshold of 0.01% is only 60% of that in the standard case. This means that the number of paths is more sensitive to threshold reduction than to threshold rise. If the

threshold is lowered further, it can trigger a dramatic increase in the number of paths and lead to a significant amount of additional computation time. Therefore, appropriately raising the threshold can simplify the calculation process by eliminating unimportant pathways.

In terms of each stage, the number of paths in Stage 0 and Stage 1 is less affected by the change of threshold. Because the carbon emissions of most of the pathways in these two stages are relatively considerable, larger than the maximum threshold in the sensitivity analysis. At the same time, it also indicates that there are many key carbon emission pathways in Stage 0 and Stage 1, which are the focus of carbon emission reduction. For the paths at Stage 2 and Stage 3, the number of paths decreases rapidly as the threshold rises. There are many non-significant pathways in these two stages, which are not the critical for the carbon emissions from older people.



**Figure S2. Percentage changes in the number of paths by different thresholds.**