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Impact of Public Health Emergencies on General Recreational Behaviors of Urban Residents in Nanjing of China During the COVID-19 Outbreak in July 2021

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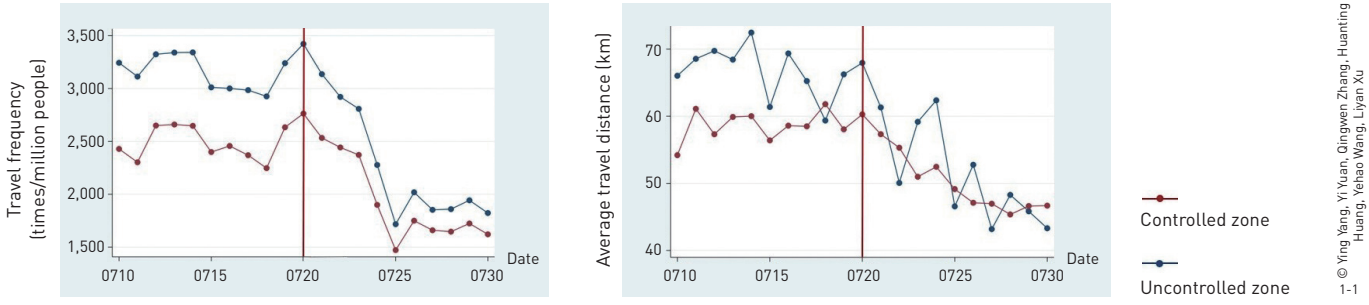
Supplementary Difference-in-Differences Results

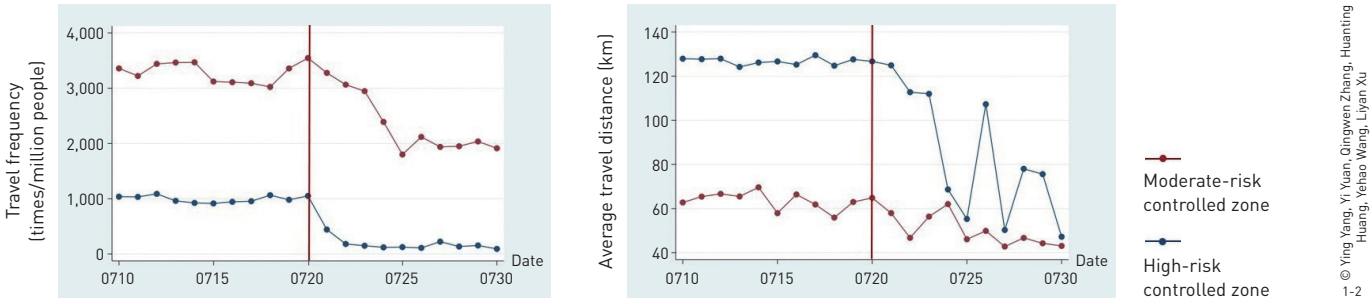
1 Impact of Hierarchical Control Policies on Residents' Recreational Travel Behaviors

1.1 Parallel Trend Test Results

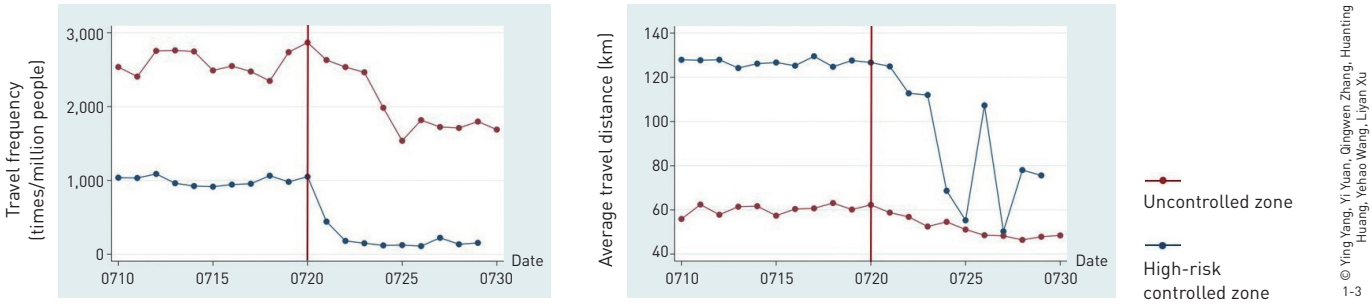
The parallel trend assumption aims to verify whether differences in travel frequency and average travel distance between the treatment and control groups would have remained constant over time in the absence of control policies. Results shown in Figure 1 prove the same trend of these groups. After July 20, 2021, the day of outbreak and when the hierarchical control policies were implemented, trends of the three treatment and control groups were different. For example, the moderate- and high-level control policies led to different levels of decrease in the travel frequency, and the numbers of days to reach the maximum decrease also varied under these two levels of policies. Meanwhile, changes of pandemic risk level led to the fluctuation of the average travel distance. Figures 1-2 and 1-3 show that trends in the average travel distance are similar in moderate- and high-risk controlled zones, while greater changes are seen in the latter.



1-1. Parallel trend test for controlled and uncontrolled zones



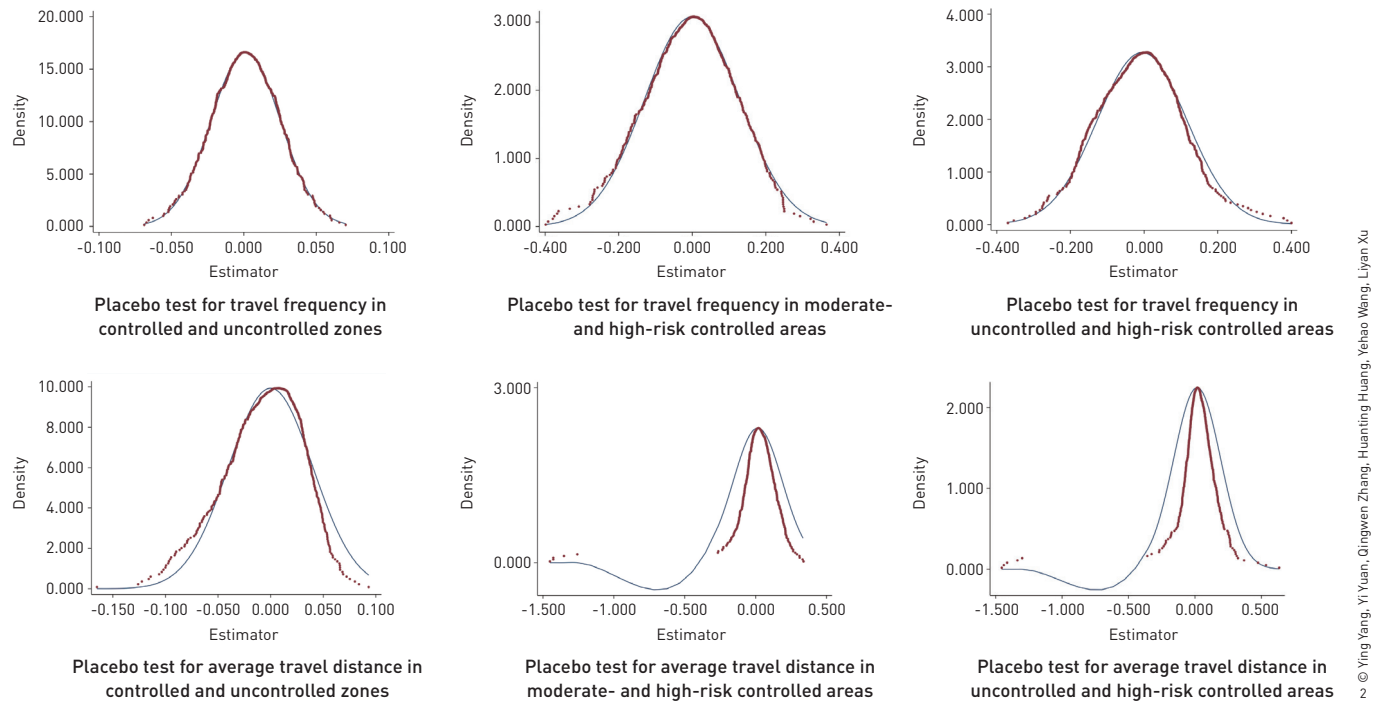
1-2. Parallel trend test for moderate- and high-risk controlled zones



1-3. Parallel trend test for uncontrolled and high-risk controlled zones

1.2 Placebo Test Results

To exclude the possibility that the changes in travel frequency and average travel distance are influenced by time variation, the study conducted the placebo test by randomly selecting pseudo-experimental groups. Results in Figure 2 show that the distribution of their regression coefficients in the three treatment and control groups is mainly around 0, indicating no problem of missing variables in the model setting. This confirms that the regression results of the treatment and control groups divided according to hierarchical control policies are robust.

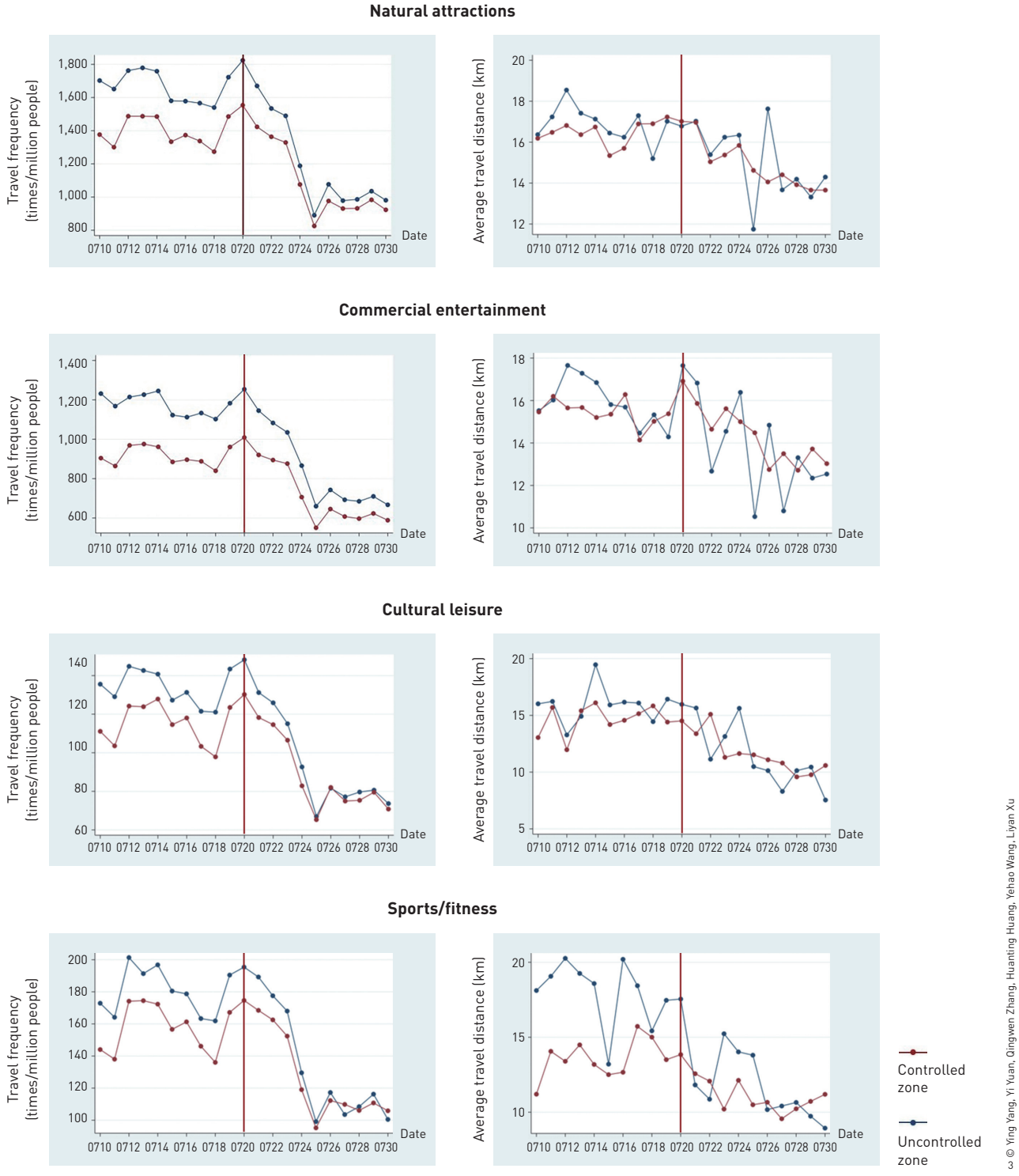


2. Placebo test results for the three experiments

2 Differences in the Impact of Hierarchical Control Policies on Different Recreational Travel Behaviors

2.1 Parallel Trend Test Results

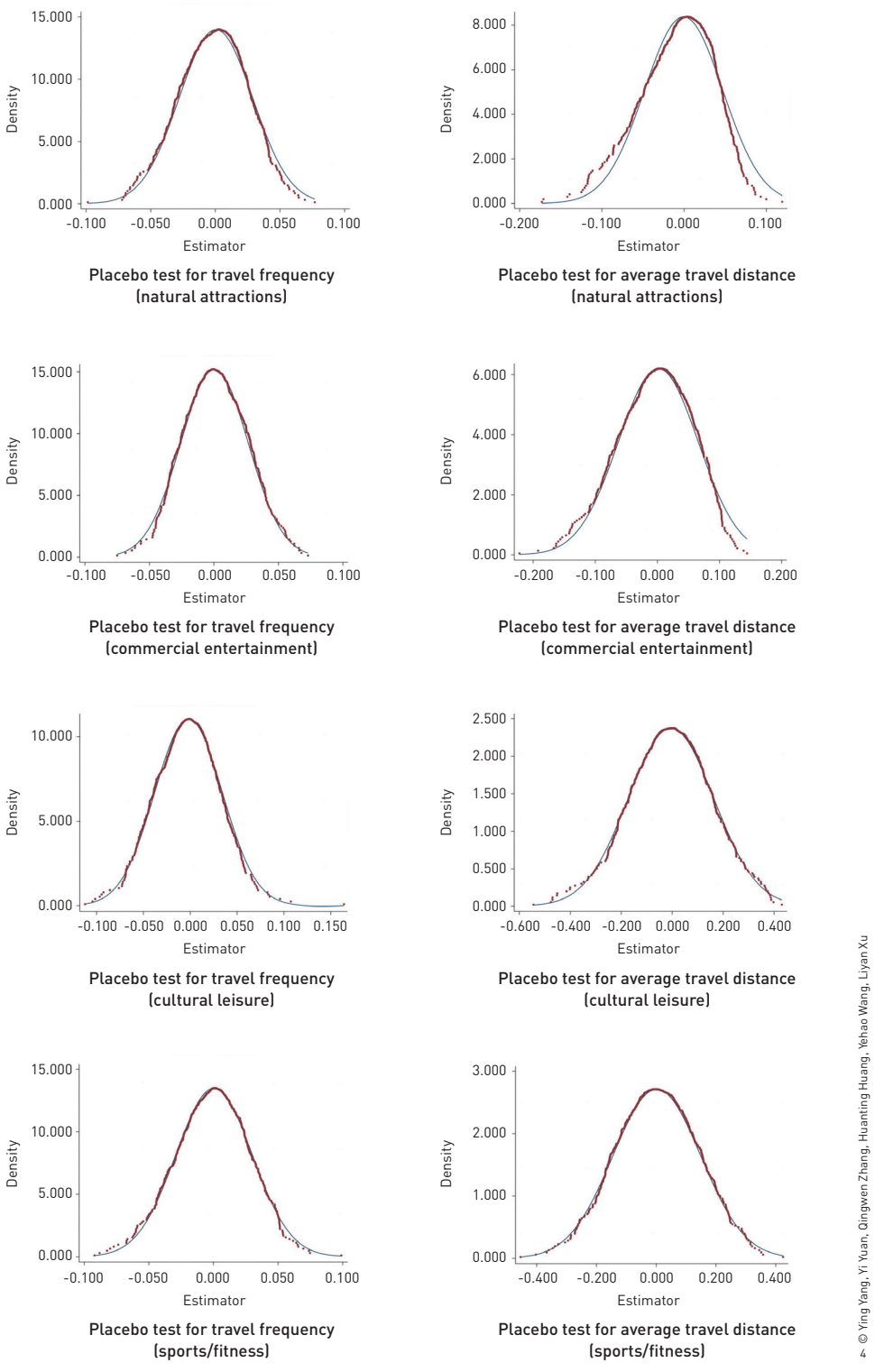
Results of the parallel trend test (Fig. 3) demonstrate similar trends of residents' travel frequency of the four types of recreational behaviors between the treatment and control groups before July 20, 2021. However, following the implementation of the hierarchical control policies, significant differences emerged in the decrease of travel frequency of all the recreational behaviors. Also, in the controlled zones, residents' average travel distances regarding the four types of recreational behaviors significantly fluctuated.



3. Parallel trend test for four types of recreational travel behaviors

2.2 Placebo Test Results

To exclude the possibility that the changes in travel frequency and average travel distance are influenced by time variation, the study conducted the placebo test by randomly selecting pseudo-experimental groups. The placebo test results for the four types of recreational behaviors (Fig. 4) demonstrate that the distribution of their regression coefficients is mainly around 0, indicating no problem of missing variables in the model setting. This confirms that the regression results of the treatment and control groups divided according to hierarchical control policies are robust.



4. Placebo test for four types of recreational behavior

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突发公共卫生事件对城市居民广义游憩行为的影响——以中国南京市2021年7月新型冠状病毒（COVID-19）感染事件为例

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双重差分法相关分析

1 分级管控政策对居民游憩出行行为的影响

1.1 平行趋势检验结果

平行趋势假设旨在验证管控政策实行前，实验组与对照组的出行频次与出行平均距离具有相似的变化趋势。从三组实验组与对照组的变化趋势（图1）来看，在疫情管控政策实施之前，实验组与对照组演变趋势基本趋同。7月20日突发疫情发生、分级管控政策实施之后，三组实验组与对照组的变化有所不同。中风险、高风险区域的管控政策导致了不同的出行频次下降幅度，两种政策下达到最大下降幅度所用的天数也不一致。对于出行平均距离而言，风险等级变化会使出行距离出现不规则变化。从图1–2和图1–3可以看出，中风险、高风险管控区的出行距离变化趋势相似，但高风险区的变化幅度明显更大。

1.2 安慰剂检验结果

为排除出行频次与平均出行距离的变化受时间变动影响的可能性，研究采用随机抽取伪实验组的方法对模型进行安慰剂检验。从三组实验组与对照组的安慰剂检验结果（图2）可以看出，其回归系数分布基本都集中在0附近，说明模型设定中不存在遗漏变量的问题，依据管控政策等级划分的实验组与对照组的回归结果是稳健的。

2 分级管控政策对不同游憩行为的影响差异

2.1 平行趋势检验结果

从平行趋势检验结果（图3）可以看出，就出行频次而言，在7月20日分级管控政策实行之前，居民的4类游憩行为实验组与对照组平行趋势基本趋同；而分级管控政策实施之后，不同类型游憩的出行频次下降幅度差异较大。与此同时，实施分级管控政策后，管控区域居民的4类游憩行为的平均出行距离变化波动幅度均较大。

2.2 安慰剂检验结果

为排除出行频次与平均出行距离的变化受时间变动影响的可能性，研究采用随机抽取伪实验组的方法对模型进行安慰剂检验。从4类游憩行为的安慰剂检验结果（图4）可以看出，其回归系数分布基本都集中在0附近，说明模型设定中不存在遗漏变量的问题，依据管控政策等级划分的实验组与对照组的回归结果是稳健的。

图 1-1. 管控区与未管控区平行趋势检验
图 1-2. 中风险与高风险管控区平行趋势检验
图 1-3. 未管控区与高风险管控区平行趋势检验
图 2. 三组实验安慰剂检验
图 3. 4 类游憩行为平行趋势检验
图 4. 4 类游憩行为安慰剂检验