

# Activity-travel Behaviour of Non-workers of Different Income Group Households: Case of Bangalore City

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# Outline

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- Introduction
- Study Area
- Data
- Descriptive Analysis
- Empirical Models
- Summary and Findings



# Introduction

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- Limited information about non-worker travel patterns
- Different policy context
  
- Non-worker – homemakers, retired individuals, etc.
- Absence of temporal fixities & high level of mobility
  - Relatively more amount of time available for allocation
  - The types and no. of constraints are different
  
- Special travel needs – females, elders, etc.
- Response to policies – Shiftan (1999), Azari et al. (2013), etc.
- Land use & Infrastructure improvements – Antipova and Wang (2010)



# Introduction

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Authors	Observations
Zegras and Srinivasan (2007)	Limited non-work destinations
Chen et al. (2012)	Trip chaining and activity participation
Cheng et al. (2013)	Fewer trips; short distance travel
Srinivasan and Rogers (2004)	Accessibility to work and NMT use
Astrop et al. (1996); Palmer et al. (1997)	PT quality, cultural factors
Locantore (2006)	Lack of inclusive PT and income
Active living by design (2012)	Low physical activity level
Mallet (2001)	Fewer long-distance trips for recreation
Chen and McKnight (2007)	Fewer shopping trips
Azari et al. (2013)	Resistant to switch mode
Zhi (2009)	Time-of-day of trip making



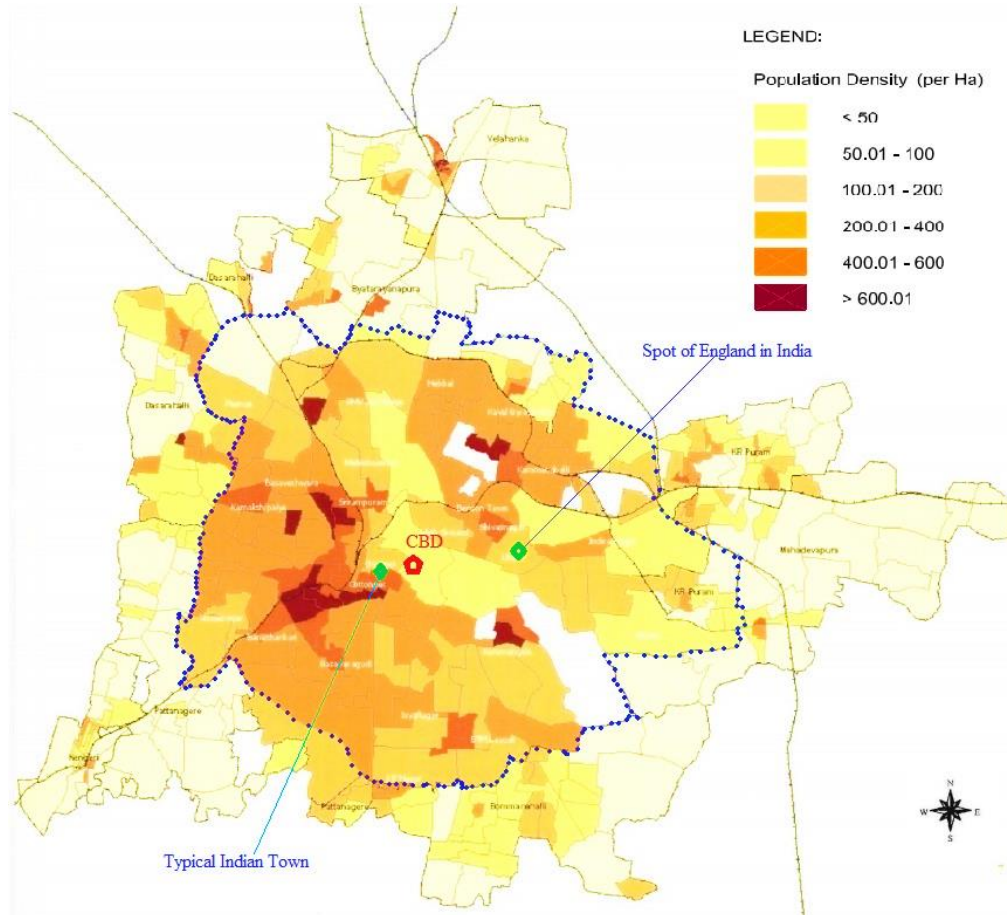
# Bangalore Context

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- Rising income inequality (Shukla, 2010)
- High-, middle-, low-, poor, 'rurban', categories (Sastry, 2008)
- public/green space confined to various 'interest groups' (Vagale, 2004)
  
- 56% of the population in non-working group (Census of India, 2011)
- 10.5% of the total daily trips (Karnataka Urban Infrastructure Development and Finance Corporation, 2007)
  
- ❖ Travel behaviour of different income group households is relevant



# Bangalore Context





# Data

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- Primary Data
  - One-day (weekday activity-travel survey)
- Secondary data – land use information
  - Bangalore Development Authority (Land use information)
- Karnataka Urban Infrastructure Development and Finance Corporation (Road Inventory, School enrolment, Employment)
- Bangalore Metropolitan Region Development Authority (Population, School enrolment, Employment)
- Income-band - (Ministry of Housing and Urban Poverty Alleviation, 2006, 2012a, 2012b)



# Descriptive Analysis

Characteristic	LIH	MIH	HIH
Average Household Size (Persons)	4.01 (1.12)*	4.07 (1.01)*	3.71 (1.27)*
Number of Workers			
0	10%	8%	1%
1	77%	60%	81%
2	13%	28%	16%
≥ 3	0%	4%	2%
Number of non-workers			
1	48%	53%	69%
2	36%	37%	28%
≥ 3	16%	10%	3%
Number of Children (age ≤ 15)			
0	53%	48%	51%
1	21%	23%	26%
2	24%	26%	21%
≥ 3	2%	3%	2%
Home Ownership Status			
Own	32%	38%	56%
Rent	68%	55%	36%
Employer Provided	0%	7%	8%
Residence Type			
Detached	21%	28%	31%
Semidetached	44%	4%	0%
Apartment	7%	66%	69%
Other	28%	2%	0%
Home Type			
1 Hall Kitchen	28%	19%	0%
1 Bedroom Hall Kitchen	54%	40%	11%
2 Bedroom Hall Kitchen	18%	37%	75%
≥ 3 Bedroom Hall Kitchen	0%	4%	14%
Income (in 1000 INR)	6.2 (3.1)*	14.1 (5.5)*	38.4 (11.2)*
Motorbike Ownership			
0	91%	26%	17%
1	9%	69%	80%
≥ 2	0%	5%	3%
Car Ownership			
0	0%	91%	24%
1	0%	9%	74%
≥ 2	0%	0%	2%
Bicycle Ownership			





# Descriptive Analysis

Characteristic	LIH	MIH	HIH
Gender			
Male	23%	26%	22%
Female	77%	74%	78%
Marital Status			
Married	65%	70%	74%
Unmarried (& Other)	35%	30%	26%
Age Group (Years)			
16-21	8%	6%	9%
21-40	32%	38%	44%
40-60	42%	42%	45%
> 60	18%	14%	2%
Education Level			
Uneducated	21%	9%	0%
SSLC (10 <sup>th</sup> )	34%	29%	20%
HSE (12 <sup>th</sup> )	20%	38%	34%
Diploma/Bachelor Degree	5%	18%	38%
Post Graduation and above	0%	6%	8%
Individual Status			
Homemaker	62%	56%	66%
Unemployed	36%	37%	29%
Retired	2%	7%	5%
Mobile Phone Ownership			
Yes	26%	69%	88%
No	74%	31%	12%
Driving License Status			
Yes	0%	18%	34%
No	100%	82%	66%
Motorbike Ownership			
Yes	0%	18%	34%
No	100%	82%	66%
Car Ownership			
Yes	0%	1%	12%
No	100%	99%	88%
Bicycle Ownership			
Yes	2%	3%	0%



# Descriptive Analysis

Stop-Making Behaviour by Activity type and by Income ( $\alpha = 0.05$ )

Characteristic	Average No. of Stop/Day		
	LIH	MIH	HIH
<b>Activity</b>			
Shopping	0.29	0.86	1.28
Pick-up/Drop-off	0.24 <sup>a</sup>	0.36 <sup>b</sup>	0.21
Eat-Out	0.00	0.14 <sup>b</sup>	0.36
Visiting (Friends/Relatives)	0.31	0.16	0.18
Recreational	0.07	0.19	0.84
Personal	0.11 <sup>a,c</sup>	0.10	0.17
Business/Medical			
Religious/Social	0.14	0.16	0.14
<b>Total</b>	<b>1.16</b>	<b>2.02</b>	<b>3.18</b>
<b>Total Daily Trip Rate</b>	<b>2.41</b>	<b>4.24</b>	<b>6.22</b>
<b>Sample Size</b>	<b>386</b>	<b>723</b>	<b>570</b>

**LIH group** makes **more visiting stops** than their counterparts in the US (**0.21** in Chen and McKnight (2007))



# Descriptive Analysis

Average Duration of Activities (in minutes) ( $\alpha = 0.05$ )

Activity Type	LIH	MIH	HIH
<b>In-home</b>			
Household Maintenance	347	338	296 <sup>b,c</sup>
Personal Maintenance	88	92	94
Child (Person) care	31	27	28
Watching TV	98 <sup>a,c</sup>	138 <sup>b</sup>	118
Family Chat	72	68	48 <sup>b,c</sup>
Other Recreational/leisure	72	68	48
<b>Out-of-home</b>			
Religious (Civic)	67	62	64
Social	38 <sup>a,c</sup>	22	21
Drop-off/Pick-up	38	22	21
Shopping	38	22	21
Personal/Household Business	36	34	35
Recreational/Leisure	31	32	46 <sup>b,c</sup>
Eat-out	31	32	46
Medical	34	33	33
<b>Total</b>	906	953	914
<b>Sample Size</b>	386	723	570

**LIH group** spends **more time on in-home maintenance** activities than their counterparts in the US (**188** min in Chen and McKnight (2007))



# Descriptive Analysis

## Modal Split by Income Group

Characteristic	LIH	MIH	HIH
<b>Mode</b>			
Walk	78%	64.8%	39.39%
Bicycle	1%	0%	0%
Bus (with walk access)	17%	12.90%	9.81%
Motorised Two-wheeler	0%	7.40%	26.50%
Auto-rickshaw (3-Wheeler)	4%	12.3%	13.59%
Car	0%	2.60%	10.71%
<b>Total</b>	100%	100%	100%
<b>Sample Size</b>	424	913	764

**LIH group walks more than** their counterparts in the US (**51%**, Chen and McKnight (2007))



# Descriptive Analysis

Modal Split Based on Activity Purpose

Activity Type	Mode	LIH	MIH	HIH
<b>Shopping</b>	Walk	84%	66%	45%
	Two-wheeler	0%	6%	25%
	Auto-Rickshaw	2%	9%	14%
	Bus	14 %	18%	12%
	Car	0%	1%	4%
	Total Trips	134	487	414
<b>Drop-off/Pick-up</b>	Walk	91%	90%	14%
	Two-wheeler	0%	7%	55%
	Auto-Rickshaw	0%	0%	0%
	Bus	9%	3%	0%
	Car	0%	0%	31%
	Total Trips	65	97	58
<b>Eat-out</b>	Walk	0%	2%	0%
	Two-wheeler	0%	13%	44%
	Auto-Rickshaw	0%	24%	24%
	Bus	0%	7%	5%
	Car	0%	54%	27%
	Total Trips	0	26	49
<b>Visiting Friends/Relatives</b>		<b>75%</b>	<b>48%</b>	<b>11%</b>
	Two-wheeler	0%	13%	19%
	Auto-Rickshaw	9%	17%	34%
	Bus	16%	12%	11%
	Car	0%	10%	25%
	Total Trips	71	36	28
<b>Recreational</b>	Walk	72%	67%	67%
	Two-wheeler	0%	8%	20%
	Auto-Rickshaw	7%	16%	0%
	Bus	21%	8%	6%
	Car	0%	1%	7%
	Total Trips	44	88	105
<b>Personal Business/Medical</b>	Walk	70%	45%	13%
	Two-wheeler	0%	14%	23%
	Auto-Rickshaw	5%	35%	32%
	Bus	25%	6%	12%
	Car	0%	0%	20%
	Total Trips	62	88	64
<b>Religious/Social</b>		<b>74%</b>	<b>76%</b>	<b>54%</b>
	Two-wheeler	0%	1%	2%
	Auto-Rickshaw	2%	1%	0%
	Bus	0%	0%	0%
	Car	0%	0%	0%
	Total Trips	0	0	0



# Descriptive Analysis

Trip Distance by Mode\* (in Km) ( $\alpha = 0.05$ )

Mode	LIH	MIH	HIH
Walk	2.3	1.3	1.7
Bus	5.7	5.9	7.6 <sup>b,c</sup>
Auto-rickshaw	4.8 <sup>a,c</sup>	8.0 <sup>b</sup>	11.1
Motorised Two-wheeler	0.0	2.3	2.8
Car	0.0	18.9	18.7

**LIH group walks long distance on foot** than their counterparts in the UK (1.8 km, Bayliss, 2009); But **short distance on taxi mode (14 km in UK)**



# Descriptive Analysis

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## Time of Day Distribution of Trips to Different Activities

Time-of-Day	LIH	MIH	HIH
<b>4:00-6:00</b>	0%	0%	3%
<b>6:00-8:00</b>	4%	6%	6%
<b>8:00-10:00</b>	19%	3%	7%
<b>10:00-12:00</b>	21%	16%	13%
<b>12:00-14:00</b>	16%	10%	11%
<b>14:00-16:00</b>	18%	17%	10%
<b>16:00-18:00</b>	<b>7%</b>	<b>23%</b>	<b>27%</b>
<b>18:00-22:00</b>			
<b>Total</b>	100%	100%	100%
<b>Sample Size</b>	424	913	764



# Descriptive Analysis

Daily Pattern (Trip-Chain) Type Distribution

Trip-Chain Type	LIH	MIH	HIH
Simple	72%	63%	62%
Simple in Multiple Tours	18%	24%	19%
Complex	10%	13%	19%
Total	100%	100%	100%
Sample Size	386	723	570

Share of **simple daily patterns** for the **LIH group** -(90% for Bangalore against **55% for the low-income group in the US**) (Clifton and Handy, 2001).





# Descriptive Analysis

Allocate more time on discretionary activities

MIH group – more sensitivity to income

LIH group – insensitive to mixed residential development

## Out-of-Home Activity Duration

Independent Variable	MIH		HIH	
	MAINT	DISCR	MAINT	DISCR
Constant	<b>0.000</b>	<b>0.205</b>	<b>0.314</b>	<b>0.168</b>
No. of Workers	<b>0.109</b>			
Detached/Semidetached Home		<b>0.011</b>		
Own Personal Vehicle			0.125	0.108
Income (in 1000 INR)	<b>0.011</b>	<b>0.028</b>	<b>0.024</b>	0.030
TV dials				<b>-0.086</b>
Main road			<b>-0.075</b>	<b>-0.039</b>
(mixed residential development)				<b>-0.014</b>
Age (years)			<b>-0.019</b>	<b>-0.009</b>
Male	-0.008		-0.011	0.010
Educated beyond 12 <sup>th</sup>		0.007		0.018
% of Mixed Residential Area			0.004	0.002
				<b>0.001</b>
				<b>0.007</b>
Sample Size	386	386	723	723
Adjusted R-Square	0.310	0.356	0.401	0.385
				0.418
				0.398



# Descriptive Analysis

## Daily Pattern (Trip-Chain) Type Distribution

Independent Variables	LIH	MIH	HIH
		-0.146	-0.205
		-0.009	-0.006
			0.087
		0.024	0.028
		0.009	0.014
Ow...		0.003	0.006
Partic... gious		0.026	0.011
activity			
Distance from CBD (km)	0.021	0.018	0.009
% of Mixed Residential Area	-0.008	-0.011	-0.013
<b>Sample Size</b>	386	723	570
<b>Adjusted R-Square</b>	0.282	0.321	0.348

LIH group – more sensitive to distance to home from CBD  
 H...  
 mixed residential Development



# Descriptive Analysis

## Model Results

HIH group – more sensitive to income

HIH group – more sensitive to

HIH group – more sensitive to mixed residential development

	LIH	MIH	HIH
Income (in 1000 INR)	-0.002	<b>-0.012</b>	<b>-0.044</b>
Personal Vehicle Ownership		-0.056	<b>-0.102</b>
Activity is Medical	-0.009	-0.011	-0.026
Trip Distance (km)	<b>-0.086</b>	<b>-0.113</b>	<b>-0.130</b>
% of Mixed Residential Area	0.009	<b>0.048</b>	<b>0.061</b>
Sample Size	424	913	760
Adjusted Rho-Square	0.282	0.295	0.322



# Summary and Conclusions

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- ❑ The LIH group participates in out-of-home activities at a lesser rate
- ❑ LIH group conducts less trip chains
  
- MIH - activity durations sensitive to income and vehicle ownership
- Mixed residential development – Identical for MIH and HIH
  
- HIH - trip distance on walking
- Mixed residential development on walk

Thank You