Unveiling the Urban Mosaic of Metro Vancouver: Shaping a New Urban Identity

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Abstract. Vancouver has always had an open and tolerant social attitude and multiculturalism as part of the city's identity, which has attracted many immigrants. The city in modern society is complex, gathering people with different occupations, personalities and identities, and their distribution in space also has differentiated clusters. This paper shares findings from researching the different characteristics of people in different sub-divisions of the metro Vancouver area, and uses Urban Mosaic maps to present them. This paper aims to provide a more intuitive data visualization to show the differences between urban identity and regional development of people in a city, and to provide a possibility to serve the future planning and policy making of the city.

Keywords: urban mosaic, factorial ecology, geography.

1. Introduction

Metro Vancouver is a vibrant and diverse metropolitan area on Canada's west coast that has long been known for its cultural richness, beautiful surroundings and economic vitality. The collection, processing, and transportation of natural resources have dominated the history of the metro Vancouver's economic development, and the formation of the urban community as well as the development of the core area have been influenced by the natural resource sector. However, this situation changed in the 1970s with an economic shift from the natural resource sector and traditional manufacturing to commerce and services. As a result of globalization and the transformation of Vancouver's local industries, tourism, business and real estate are becoming major industries in metro Vancouver. Most notably, it became Canada's gateway to the Asia-Pacific region, attracting significant immigration and investment [1]. Large numbers of immigrants have made Vancouver more culturally diverse, with different cultural groups and ethnic communities emerging, building new business networks and city institutions. Whether it's the wave of immigrants from Hong Kong in the 1990s, mainland China in the early 21st century, or India in the 2010s, metro Vancouver's urban cultural system has been impacted significantly. First-generation immigrants tend to retain their original habits and cultural practices, tending to settle in specific areas with the same ethnic group. Apart from that, Vancouver also has an open and tolerant attitude towards non-traditional ideas, embracing LGBTQ+, environmental movements, and avant-garde art activities.

This economic and cultural diversity makes metro Vancouver's urban identity very complex. Metro Vancouver has cultural barriers between different regions, and similarly people in different areas have different local identities. Urban identity, as a concept used to understand the city and its characteristics (including the characteristics of its citizens), has been divided into three parts: identity of urban, represented by landscape architecture and geological environment, identity in urban, represented by social structure and identity, and identity for urban, represented by symbols and narratives [2].

In order to analyze the complex urban identity of the metro vancouver, the concept of urban mosaic can be introduced. The metaphor of the 'urban mosaic' describes the city as a patchwork of different neighborhoods and communities, each with its own unique cultural, class, and environmental characteristics, and the different mosaics are pieced together to form a complete urban identity. In the context of the city's residential division, the structure of the city is similar to the 'mosaic of the social world'. Similar groups of people come together to form the features of their respective areas [3]. In

addition to reflecting cultural diversity, urban mosaics can link time and space within the city, reflecting the different stages of development in the city. The different mosaics in the city have been developed with varying degrees of newness creating a layered urban identity that has evolved over time. Urban mosaic can better explain the differences between various areas of a city, sometimes revealing social and economic divides [4]. This is particularly evident in gentrified neighborhoods and areas in decline. Urban mosaic can reveal these differences and problems, so that targeted urban policy can be enacted, and infrastructure built to strengthen a shared identity. For example, preserving historic neighborhoods, controlling gentrification and real estate market expansion, and revitalizing marginalized areas can help maintain a balanced and inclusive urban identity, maintaining the tension and harmony within the mosaic.

2. Research method
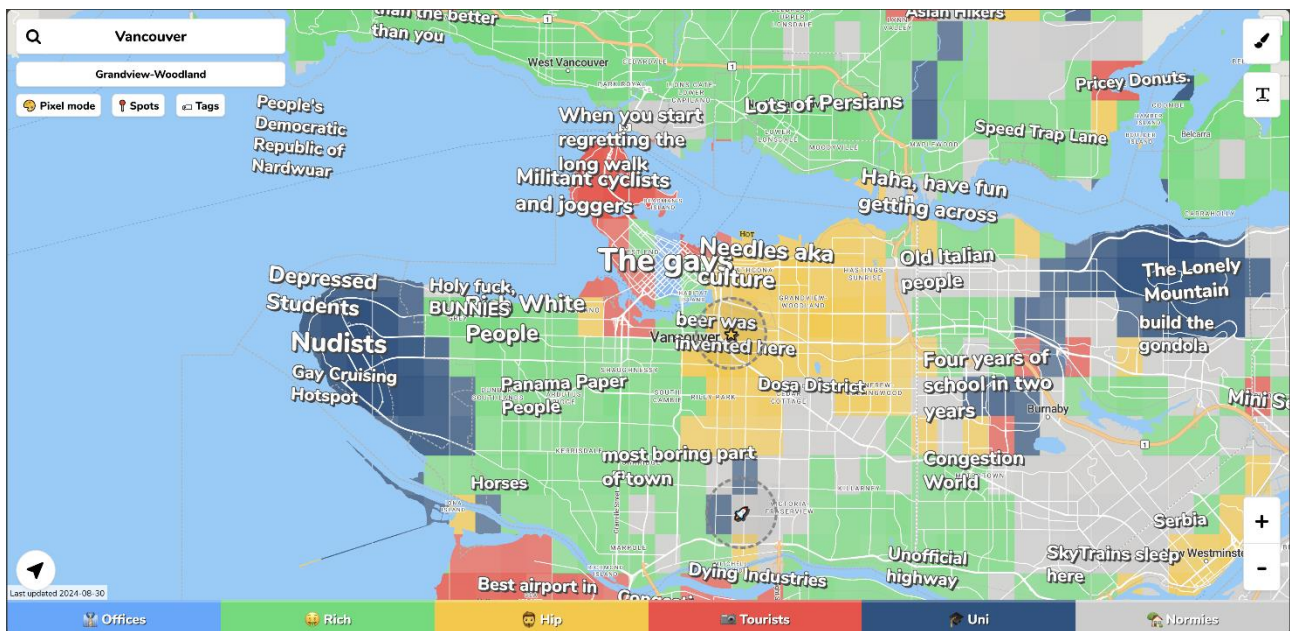
2.1. Inspiration

Fig. 1 Hoodmaps in vancouver[12]

This research was inspired by Hoodmaps, a crowdsourced tagging online map website. It allows locals to label different neighborhoods in the city according to subjective ideas and color code different areas on the map to represent different characteristics. Hoodmaps provide an intuitive visual representation of urban culture and interesting insights into local communities. However, this type of subjectively labeled map contains simplifications of complex urban issues, personal stereotypes, and exaggerated representations. Although Hoodmaps is a visual representation of urban mosaic, these shortcomings make it unsuitable as the main support for academic research [5]. Therefore, this study will use factor analysis and Geographic information system based on 2021 Statistics Canada data to create a more objective urban mosaic map to explore the socio-spatial divisions within metro Vancouver (Fig.1).

2.2. Study area

The study area focuses on metro Vancouver, a federation of 21 municipalities, an electoral district and one treaty First Nation in the region of the same name. It includes Anmore, Belcarra, Bowen Island, Burnaby, Coquitlam, Delta, Electoral Area A, Langley City, Langley Township, Lions Bay, Maple Ridge, New Westminster, North Vancouver City, North Vancouver District, Pitt Meadows, Port Coquitlam, Port Moody, Richmond, Surrey, scəẃaθən məsteyəxʷ [6], Vancouver, West Vancouver, White Rock.

2.3. Factor analysis

In the face of the city's complex spatial patterns and information flows, a quantitative approach can be used to gain insight into the inner workings of the city, and 'factor ecology' can be used to reveal the underlying relational structure of a place. In terms of data analysis, this study brings together data from multiple fields such as housing, occupation, family, ethnicity, beliefs, income, and education (Fig.2). It reveals how different factors affect spatial segregation and how it varies from community to community or sector to sector. It can group variables that are related to each other and go about pooling large amounts of complex data into smaller sets of factors that can explain potential structure in the city. Subsequently a subset of factors can be visualized on a map by correlation strength to draw a kind of urban mosaic.

Rotated Factor Pattern

		Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8
multi	Multi-generational Households as Percentage of Total Households	-34	72 *	-32	-7	7	17	-6	-11
single	Not married and not living common law – Never married, Both sexes, as percentage of total population 15+	44 *	17	10	14	3	21	-39	-17
separt	Not married and not living common law – Separated, Both sexes, as percentage of total population 15+	56 *	-12	-18	13	-5	-14	0	15
divorc	Not married and not living common law – Divorced, Both sexes, as percentage of total population 15+	71 *	-26	-1	12	-8	-13	22	11
widowd	Not married and not living common law – Widowed, Both sexes, as percentage of total population 15+	22	0	-11	0	2	-9	78 *	-1
mckids	Married couple families with children, as share of total households	-74 *	39	-19	-14	16	9	-16	-11
spar_f	One-parent families in which the parent is a woman+, as share of total households	-7	12	-17	9	26	24	-3	-3
spar_m	One-parent families in which the parent is a man+, as share of total households	-16	8	-22	4	-1	-1	-7	-1
V6214	Labour-Total Sex/Unemployment rate ; Both sexes	16	4	1	5	15	13	5	-1
lb_ocan	Share of employed labour force working outside Canada	-5	-5	10	-3	16	9	1	2
lb_home	Share of employed labour force working at home	-5	-35	71 *	-10	4	8	-1	-1
lb_nfix	Share of employed labour force with no fixed workplace address	1	39	-70 *	7	-6	-7	-9	3
lb_affh	Share of labour force in agriculture, forestry, fishing, and hunting	-7	10	-13	2	-11	-9	-5	1
lb_mqog	Share of labour force in mining, quarrying, oil and gas extraction	-2	-5	5	3	-1	-4	2	2
lb_cons	Share of labour force in construction	-12	-3	-73 *	5	-10	-21	-10	6
lb_real	Share of labour force in real estate and rental and leasing	-6	-13	18	-7	10	8	5	-2
lb_tran	Share of labour force in transportation and warehousing	3	66 *	-35	1	1	-1	-2	4
lb_mnfg	Share of labour force in manufacturing	-3	16	-28	6	-1	-5	-4	2
lb_info	Share of labour force in information and cultural industries	27	-11	51 *	-1	-8	2	-18	0
lb_fnin	Share of labour force in finance and insurance	-11	-9	28	-11	12	12	2	3
lb_prof	Share of labour force in professional, scientific, and technical services	0	-25	65 *	-10	11	7	1	0
lb_hcss	Share of labour force in health care and social assistance	2	-4	1	2	1	0	1	-1
in_med	Median HH income as percentage of regional DA median	-84 *	5	12	-16	-11	-16	-14	-4
imm1980	Percentage of population private households who immigrated before 1980	-4	-8	12	-9	-22	18	74 *	-7
imm8090	Percentage of population private households who immigrated 1980-1990	-1	21	7	-11	-4	70 *	13	-10
imm9100	Percentage of population private households who immigrated 1991-2000	3	23	6	-16	32	72 *	-3	-10
imm2010	Percentage of population private households who immigrated 2001-2010	1	24	2	-13	67 *	25	-12	-5
imm2115	Percentage of population private households who immigrated 2011-2015	7	15	2	-8	76 *	0	-6	-1
imm2621	Percentage of population private households who immigrated 2016-2021	31	25	13	-10	45 *	4	-13	10
immecon	Economic immigrants 1980-2021 as share of total population	3	-12	26	-16	70 *	45 *	-9	-1
immfaml	Family immigrants 1980-2021 as share of total population	4	78 *	-16	-11	21	31	-6	-9
immrefu	Refugee immigrants 1980-2021 as share of total population	18	8	-17	-2	10	11	-5	-2
ed_ps	Education:postsecondary certificate, diploma, or degree	6	-37	64 *	-14	11	-7	-11	3
ed_ca	Education:postsecondary study in different province of Canada	13	-30	54 *	-4	-19	-14	-8	-5
ed_us	Education:postsecondary study in the U.S.	-3	-16	35	-5	9	-4	-1	0
ed_eu	Education:postsecondary study in Europe	21	-19	49 *	-9	2	-12	-11	5
ed_af	Education:postsecondary study in Africa	3	-2	3	0	4	-3	-3	6
ed_as	Education:postsecondary study in Asia	-2	26	1	-14	76 *	24	1	-5
moblip	Intraprovincial migration rate, 1 year	12	-8	-7	10	-4	-10	-4	84 *
mobixp	Interprovincial migration rate, 1 year	17	0	15	2	3	-5	-4	6
moblex	External migration rate, 1 year	13	5	13	-9	15	9	-9	-3
mob5ip	Intraprovincial migration rate, 5 year	11	-27	-12	11	-6	-26	-4	74 *
mob5xp	Interprovincial migration rate, 5 year	34	-14	21	5	1	-7	-15	7
mob5ex	External migration rate, 5 year	30	36	13	-12	33	2	-10	2
vm_sa	Visible minority, South Asian, share of total population in private households	-4	93 *	-21	-7	8	-7	-2	-7
vm_ch	Visible minority, Chinese, share of total population in private households	-8	-21	20	-13	37	75 *	7	-5
vm_bk	Visible minority, Black, share of total population in private households	20	6	-7	6	5	-6	-8	4
vm_fl	Visible minority, Filipino, share of total population in private households	17	6	-8	-4	32	13	-8	-3
vm_ar	Visible minority, Arab, share of total population in private households	10	-1	-4	0	12	-3	-3	0
vm_la	Visible minority, Latin American, share of total population in private households	25	-5	7	3	4	0	-7	3
vm_se	Visible minority, Southeast Asian, share of total population in private households	8	7	-7	-2	0	25	-2	-2
vm_wa	Visible minority, West Asian, share of total population in private households	5	-16	12	-5	20	-7	0	4
vm_kr	Visible minority, Korean, share of total population in private households	6	-12	8	-4	18	1	5	13
vm_jp	Visible minority, Japanese, share of total population in private households	9	-11	18	-3	3	3	-2	-2
vm_ot	Visible minority, Other and/or Multiple, share of total population in private households	6	3	5	-4	8	20	-4	2
ii_fn	Indigenous identity, single responses, First Nations, percentage of population in private households	11	-14	-20	83 *	-20	-19	-9	5
ii_mt	Indigenous identity, single responses, Métis, percentage of population in private households	12	-6	-8	91 *	-10	-9	-5	4
ii_in	Indigenous identity, single responses, Inuk(Inuit), percentage of population in private households	2	-1	-1	2	-1	0	0	1
ii_ml	Indigenous identity, multiple responses and n.i.e., percentage of pop in private households	2	-2	-2	5	-2	-1	-1	1
ir_tr	Registered or Treaty Indians, as percentage of population in private households	11	-2	-1	90 *	-5	-3	0	3
ia_sio	Indigenous Ancestry, Single Indigenous Ancestry Only, percentage of population in private households	11	0	-2	84 *	-1	0	-2	5
ia_mio	Indigenous Ancestry, Multiple Indigenous Ancestry Only, percentage of population in private households	2	0	-1	1	0	0	-2	5
ia_sin	Indigenous Ancestry, Single Indigenous and non-Indigenous Ancestries, percentage of population in private households	9	-22	-19	53 *	-29	-26	-16	4
ia_min	Indigenous Ancestry, Multiple Indigenous and non-Indigenous Ancestries, percentage of population in private households	2	-1	-4	3	-2	-2	0	2
rl_bud	Religion, Buddhist, percentage of population in private households	4	-13	4	-6	21	65 *	3	-7
rl_hin	Religion, Hindu, percentage of population in private households	5	66 *	-6	-5	25	-14	3	-2
rl_jws	Religion, Jewish, percentage of population in private households	8	-9	23	-4	-2	1	1	-8
rl_mus	Religion, Muslim, percentage of population in private households	9	15	2	-5	19	0	1	0
rl_skh	Religion, Sikh, percentage of population in private households	-6	90 *	-23	-6	4	0	1	0
rl_cth	Religion, Catholic, percentage of population in private households	7	-22	6	-6	4	9	8	-1
rl_mrm	Religion, Latter Day Saints, percentage of population in private households	0	-2	-5	1	-3	-3	2	1
rl_jwt	Religion, Jehovah's Witness, percentage of population in private households	7	-1	-5	2	1	-3	2	1
rl_och	Religion, All other Christian Traditions, percentage of population in private households	-11	-51 *	-18	4	-9	-31	23	4
rl_ind	Religion, Traditional (North American Indigenous) Spirituality, percentage of population in private households	2	0	2	31	-1	-1	1	-4
rl_oth	Religion, Other religions and spiritual traditions, percentage of population in private households	21	-12	9	8	-2	-3	-3	2
h_own	Share of private households in owner occupied units	-77 *	-12	-5	-11	-1	-2	12	5
h_rnt	Share of private households in renter occupied units	78 *	12	5	11	2	2	-12	-5
h_cnd	Share of private households in condominiums	58 *	-12	26	-1	12	-5	6	18
h_p60	Share of occupied private housing units built before 1960	0	-15	23	0	-12	-5	5	-6
h_p21	Share of occupied private housing units built 2016-2021	0	10	6	-5	4	11	-4	62 *
V4132	Housing-Total Sex/Total-Owner households in non-farm, non-reserve private dwellings-25% sample data/% of owner households with a mortgage	-2	29	-14	8	8	-34	-53 *	20
h_sst	Share owners and tenants spending 30 percent or more of income on shelter	45 *	-6	6	-9	-5	37	13	-4
h_sfm	Share of occupied private dwellings that are single-detached houses	-77 *	-20	-21	-1	-9	-4	1	-4
h_apl	Share of occupied private dwellings that are apartments <5 stories	77 *	-3	10	8	4	-10	-1	0
h_aph	Share of occupied private dwellings that are apartments 5+ stories	38	-12	8	0	2	5	-4	2
h_mob	Share of occupied private dwellings that are movable dwellings	1	-3	-9	7	-7	-5	4	4
jt_dr	Commute as driver of car, truck or van, as share of employed labor force	-33	15	-64 *	5	-15	-17	4	12
jt_tr	Commute by public transit, as share of employed labor force	41 *	12	21	3	2	21	27	-8
jt_ld	Commute time over 1 hour, as share of employed labor force	-1	18	-56 *	10	6	-14	-9	13

Printed values are multiplied by 100 and rounded to the nearest integer. Values greater than 0.4 are flagged by an '*'.

		Factor16	Factor17	Factor18	Factor19	Factor20	Factor21	Factor22
multi	Multi-generational Households as Percentage of Total Households	-4	6	7	9	0	0	0
single	Not married and not living common law – Never married, Both sexes, as percentage of total population 15+	8	-4	-4	-4	13	2	5
separt	Not married and not living common law – Separated, Both sexes, as percentage of total population 15+	1	-4	47 *	5	-4	-2	1
divorc	Not married and not living common law – Divorced, Both sexes, as percentage of total population 15+	0	-1	11	0	-2	3	-3
widowd	Not married and not living common law – Widowed, Both sexes, as percentage of total population 15+	-7	-1	9	6	1	0	-1
mckids	Married couple families with children, as share of total households	-1	1	10	7	-4	2	3
spar_f	One-parent families in which the parent is a woman's, as share of total households	12	-1	73 *	4	4	3	-1
spar_m	One-parent families in which the parent is a man's, as share of total households	-1	-1	11	2	-4	0	-1
V6214	Labour-Total Sex/Unemployment rate ; Both sexes	4	-4	4	-1	0	-5	2
lb_ocan	Share of employed labour force working outside Canada	-2	0	2	0	-2	1	4
lb_home	Share of employed labour force working at home	-4	1	-10	-21	5	-12	0
lb_nfix	Share of employed labour force with no fixed workplace address	4	-5	-7	-8	6	-8	-8
lb_affh	Share of labour force in agriculture, forestry, fishing, and hunting	-4	89 *	-1	-1	-3	-10	-4
lb_mqog	Share of labour force in mining, quarrying, oil and gas extraction	0	-1	-2	-1	-1	-2	-1
lb_cons	Share of labour force in construction	0	-5	-10	-10	6	-13	-4
lb_real	Share of labour force in real estate and rental and leasing	-1	-4	-3	-7	-1	-4	-1
lb_tran	Share of labour force in transportation and warehousing	5	4	-4	0	-2	-7	-2
lb_mnfg	Share of labour force in manufacturing	4	-1	4	86 *	14	-6	0
lb_info	Share of labour force in information and cultural industries	12	-20	-21	-14	14	-14	-4
lb_fnin	Share of labour force in finance and insurance	1	-10	0	-9	0	-7	-1
lb_prof	Share of labour force in professional, scientific, and technical services	-7	-18	-5	-16	1	-12	0
lb_hcss	Share of labour force in health care and social assistance	3	-8	2	-5	-2	95 *	3
in_med	Median HH income as percentage of regional DA median	-4	-5	-2	-3	-2	2	-3
imm1980	Percentage of population private households who immigrated before 1980	-2	-6	-9	-9	-7	2	0
imm8090	Percentage of population private households who immigrated 1980-1990	-2	-3	10	-3	3	4	9
imm9100	Percentage of population private households who immigrated 1991-2000	0	-1	3	1	0	0	8
imm2010	Percentage of population private households who immigrated 2001-2010	8	-1	7	0	0	2	12
imm2115	Percentage of population private households who immigrated 2011-2015	2	-2	11	-3	6	-2	-6
imm2621	Percentage of population private households who immigrated 2016-2021	16	-9	-13	12	11	-4	0
immecon	Economic immigrants 1980-2021 as share of total population	-2	-9	1	0	0	0	7
immfaml	Family immigrants 1980-2021 as share of total population	0	6	5	8	3	1	0
immrefu	Refugee immigrants 1980-2021 as share of total population	40 *	-3	8	6	18	4	12
ed_ps	Education:postsecondary certificate, diploma, or degree	-2	-22	-19	-18	4	6	0
ed_ca	Education:postsecondary study in different province of Canada	-3	-15	-12	-15	2	5	-6
ed_us	Education:postsecondary study in the U.S.	3	-1	-9	-1	-5	-2	1
ed_eu	Education:postsecondary study in Europe	2	-9	-7	10	10	1	-6
ed_af	Education:postsecondary study in Africa	-6	1	0	-1	0	0	2
ed_as	Education:postsecondary study in Asia	15	1	0	3	2	-6	2
moblip	Intraprovincial migration rate, 1 year	7	1	-3	1	2	-1	2
moblxp	Interprovincial migration rate, 1 year	6	1	0	0	3	-6	4
mob5ip	Intraprovincial migration rate, 5 year	-2	-1	3	-9	3	-4	2
mob5xp	Interprovincial migration rate, 5 year	-2	0	5	0	-2	-3	0
mob5ex	External migration rate, 5 year	-2	-4	-10	-2	6	4	-2
vm_sa	Visible minority, South Asian, share of total population in private households	5	-7	-11	2	15	-8	0
vm_ch	Visible minority, Chinese, share of total population in private households	1	-3	0	5	-3	1	-1
vm_bk	Visible minority, Black, share of total population in private households	-4	-8	6	4	2	-3	5
vm_fl	Visible minority, Filipino, share of total population in private households	88 *	-2	8	3	4	3	3
vm_ar	Visible minority, Arab, share of total population in private households	7	2	2	5	0	16	6
vm_la	Visible minority, Latin American, share of total population in private households	6	-4	2	-4	90 *	-2	6
vm_se	Visible minority, Southeast Asian, share of total population in private households	13	-4	0	3	3	-3	4
vm_wa	Visible minority, West Asian, share of total population in private households	-3	0	-1	-2	3	-2	-3
vm_kr	Visible minority, Korean, share of total population in private households	1	-3	-1	-2	3	-1	3
vm_jp	Visible minority, Japanese, share of total population in private households	0	-4	-3	-5	2	4	2
vm_ot	Visible minority, Other and/or Multiple, share of total population in private households	-4	-4	0	0	7	6	93 *
ii_fn	Indigenous identity, single responses, First Nations, percentage of population in private households	-1	0	11	7	-3	0	-4
ii_mt	Indigenous identity, single responses, Métis, percentage of population in private households	-2	-1	6	4	3	1	-2
ii_in	Indigenous identity, single responses, Inuk(Inuit), percentage of population in private households	0	1	1	1	1	0	0
ii_ml	Indigenous identity, multiple responses and n.i.e., percentage of pop in private households	-1	1	0	1	1	0	-1
ir_tr	Registered or Treaty Indians, as percentage of population in private households	3	-3	-2	3	1	0	
ia_sio	Indigenous Ancestry, Single Indigenous Ancestry Only, percentage of population in private households	8	5	-6	-1	-1	4	-4
ia_mio	Indigenous Ancestry, Multiple Indigenous Ancestry Only, percentage of population in private households	1	-1	1	1	1	-1	1
ia_sin	Indigenous Ancestry, Single Indigenous and non-Indigenous Ancestries, percentage of population in private households	-8	-7	20	8	-10	-1	-4
ia_min	Indigenous Ancestry, Multiple Indigenous and non-Indigenous Ancestries, percentage of population in private households	1	-1	0	0	0	-1	0
rl_bud	Religion, Buddhist, percentage of population in private households	7	-1	-4	-1	0	-3	9
rl_hin	Religion, Hindu, percentage of population in private households	8	-7	1	-7	-4	3	21
rl_jws	Relgion, Jewish, percentage of population in private households	-4	0	-1	-3	2	7	1
rl_mus	Religion, Muslim, percentage of population in private households	14	-6	3	-4	6	-2	9
rl_skh	Religion, Sikh, percentage of population in private households	-2	6	0	7	-2	0	-6
rl_cth	Religion, Catholic, percentage of population in private households	-1	-12	4	11	11	0	6
rl_mrm	Religion, Latter Day Saints, percentage of population in private households	3	1	2	1	2	0	-1
rl_jwt	Religion, Jehovah's Witness, percentage of population in private households	3	1	0	3	2	1	0
rl_och	Religion, All other Christian Traditions, percentage of population in private households	15	33	-4	10	0	5	1
rl_ind	Religion, Traditional (North American Indigenous) Spirituality, percentage of population in private households	-2	1	2	-1	-2	2	-1
rl_oth	Religion, Other religions and spiritual traditions, percentage of population in private households	0	-4	-1	-1	4	0	-2
h_own	Share of private households in owner occupied units	2	0	-7	-4	2	-15	-3
h_rnt	Share of private households in renter occupied units	7	2	5	0	-9	15	3
h_cnd	Share of private households in condominiums	2	0	-7	-4	2	-3	1
h_p60	Share of occupied private housing units built before 1960	-1	2	2	-8	-2	0	1
h_p21	Share of occupied private housing units built 2016-2021	-3	1	1	2	3	6	6
V4132	Housing-Total Sex/Total-Owner households in non-farm, non-reserve private dwellings-25% sample data/% of owner households with a mortgage	1	-4	11	6	1	1	10
h_cst	Share owners and tenants spending 30 percent or more of income on shelter	-12	-8	-3	-3	6	-1	-2
h_sfm	Share of occupied private dwellings that are single-detached houses	-8	10	-4	-2	-10	-3	-5
h_apl	Share of occupied private dwellings that are apartments <5 stories	9	-7	-7	-3	-2	1	2
h_aph	Share of occupied private dwellings that are apartments 5+ stories	-2	-8	-18	-2	14	-1	-2
h_mob	Share of occupied private dwellings that are movable dwellings	-2	6	1	0	1	-2	-1
jt_dr	Commute as driver of car, truck or van, as share of employed labor force	-5	1	10	19	-11	7	-4
jt_tr	Commute by public transit, as share of employed labor force	22	-12	-1	-6	10	4	12
jt_ld	Commute time over 1 hour, as share of employed labor force	11	-12	12	-6	-10	-5	3

Printed values are multiplied by 100 and rounded to the nearest integer. Values greater than 0.4 are flagged by an '*'.

Rotated Factor Pattern

		Factor9	Factor10	Factor11	Factor12	Factor13	Factor14	Factor15
single	Not married and not living common law – Never married, Both sexes, as percentage of total population 15+	42 *	11	20	-4	14	6	11
separt	Not married and not living common law – Separated, Both sexes, as percentage of total population 15+	-5	3	-12	-1	-1	1	-2
divorc	Not married and not living common law – Divorced, Both sexes, as percentage of total population 15+	-18	1	-13	7	-5	-3	-4
widowd	Not married and not living common law – Widowed, Both sexes, as percentage of total population 15+	-12	-7	-11	-11	-3	-1	1
mckids	Married couple families with children, as share of total households	-1	-1	-2	2	-12	1	-2
spar_f	One-parent families in which the parent is a woman's, as share of total households	4	1	1	3	-10	10	3
spar_m	One-parent families in which the parent is a man's, as share of total households	4	1	2	1	-3	1	1
V6214	Labour-Total Sex/Unemployment rate ; Both sexes	2	0	4	4	1	3	5
lb_ocan	Share of employed labour force working outside Canada	2	-7	11	-2	2	1	-2
lb_home	Share of employed labour force working at home	13	-12	4	4	8	-4	-1
lb_nfix	Share of employed labour force with no fixed workplace address	8	-10	-6	2	-2	0	-1
lb_affh	Share of labour force in agriculture, forestry, fishing, and hunting	3	-10	-4	-3	-2	42	-3
lb_mqog	Share of labour force in mining, quarrying, oil and gas extraction	-1	-1	-1	1	0	0	-2
lb_cons	Share of labour force in construction	3	-12	-9	3	-1	-4	4
lb_real	Share of labour force in real estate and rental and leasing	4	0	4	4	1	3	-2
lb_tran	Share of labour force in transportation and warehousing	-19	6	-3	-4	-3	6	-13
lb_mnfg	Share of labour force in manufacturing	-9	5	-7	-5	-5	-1	5
lb_info	Share of labour force in information and cultural industries	15	3	-21	3	7	-1	0
lb_fnin	Share of labour force in finance and insurance	-4	-3	7	1	-1	-3	0
lb_prof	Share of labour force in professional, scientific, and technical services	10	-9	9	12	14	-4	0
lb_hcss	Share of labour force in health care and social assistance	1	10	-5	0	-2	1	0
in_med	Median HH income as percentage of regional DA median	4	-2	-7	3	-5	-4	-1
imm1980	Percentage of population private households who immigrated before 1980	7	13	-5	5	4	-4	2
imm8090	Percentage of population private households who immigrated 1980-1990	8	14	-4	4	-3	-2	25
imm9100	Percentage of population private households who immigrated 1991-2000	-10	13	3	7	-8	1	-5
imm2010	Percentage of population private households who immigrated 2001-2010	-10	6	3	11	-6	0	-1
imm2115	Percentage of population private households who immigrated 2011-2015	-2	8	-1	13	7	10	10
imm2621	Percentage of population private households who immigrated 2016-2021	5	3	37	5	10	18	6
immecon	Economic immigrants 1980-2021 as share of total population	-3	12	14	9	1	0	0
immfaml	Family immigrants 1980-2021 as share of total population	-3	5	0	0	-4	-1	12
immrefu	Refugee immigrants 1980-2021 as share of total population	-1	11	0	28	-5	46 *	34
ed_ps	Education:postsecondary certificate, diploma, or degree	6	-12	8	-6	2	-5	-3
ed_ca	Education:postsecondary study in different province of Canada	6	0	-6	2	30	-5	-3
ed_us	Education:postsecondary study in the U.S.	8	4	8	17	-2	-1	0
ed_eu	Education:postsecondary study in Europe	4	-6	3	9	12	0	-1
ed_af	Education:postsecondary study in Africa	-3	2	1	4	0	5	0
ed_as	Education:postsecondary study in Asia	-4	10	13	-4	4	2	2
moblip	Intraprovincial migration rate, 1 year	-4	-1	-2	-2	4	1	-3
moblxp	Interprovincial migration rate, 1 year	-2	2	11	-2	84 *	1	-3
moblex	External migration rate, 1 year	2	2	80 *	4	6	0	2
mob5ip	Intraprovincial migration rate, 5 year	-13	-2	-11	8	-1	-3	-5
mob5xp	Interprovincial migration rate, 5 year	-2	-6	3	3	68 *	-2	3
mob5ex	External migration rate, 5 year	15	-5	11	11	14	5	-1
vm_sa	Visible minority, South Asian, share of total population in private households	15	-10	7	3	1	1	-2
vm_ch	Visible minority, Chinese, share of total population in private households	4	-2	12	-15	-3	-1	-2
vm_bk	Visible minority, Black, share of total population in private households	0	3	1	5	2	5	5
vm_fl	Visible minority, Filipino, share of total population in private households	2	76 *	-2	-2	-2	2	13
vm_ar	Visible minority, Arab, share of total population in private households	-3	-4	2	9	1	84 *	1
vm_la	Visible minority, Latin American, share of total population in private households	1	11	9	2	6	2	1
vm_se	Visible minority, Southeast Asian, share of total population in private households	5	14	2	-4	0	4	86 *
vm_wa	Visible minority, West Asian, share of total population in private households	3	-3	1	85 *	1	-1	-2
vm_kr	Visible minority, Korean, share of total population in private households	-10	-2	4	7	5	1	1
vm_jp	Visible minority, Japanese, share of total population in private households	1	0	10	2	3	2	1
vm_ot	Visible minority, Other and/or Multiple, share of total population in private households	2	0	7	4	2	2	5
ii_fn	Indigenous identity, single responses, First Nations, percentage of population in private households	1	-7	-5	-4	0	1	-1
ii_mt	Indigenous identity, single responses, Métis, percentage of population in private households	1	-6	-3	-1	1	1	0
ii_in	Indigenous identity, single responses, Inuk(Inuit), percentage of population in private households	0	0	-1	0	1	1	0
ii_ml	Indigenous identity, multiple responses and n.i.e., percentage of pop in private households	-1	-1	-1	-1	1	1	-2
ir_tr	Registered or Treaty Indians, as percentage of population in private households	1	-1	1	-1	-1	1	1
ia_sio	Indigenous Ancestry, Single Indigenous Ancestry Only, percentage of population in private households	1	0	-3	-2	-1	2	1
ia_mio	Indigenous Ancestry, Multiple Indigenous Ancestry Only, percentage of population in private households	0	-1	1	0	1	1	2
ia_sin	Indigenous Ancestry, Single Indigenous and non-Indigenous Ancestries, percentage of population in private households	1	-8	-5	-14	-4	1	5
ia_min	Indigenous Ancestry, Multiple Indigenous and non-Indigenous Ancestries, percentage of population in private households	0	-1	-1	0	0	1	-1
rl_bud	Religion, Buddhist, percentage of population in private households	5	0	5	-14	-2	0	43 *
rl_hin	Religion, Hindu, percentage of population in private households	5	-9	-1	1	-9	0	-4
rl_jws	Relgion, Jewish, percentage of population in private households	8	-5	1	-4	6	0	-4
rl_mus	Religion, Muslim, percentage of population in private households	2	2	76 *	1	3	1	-5
rl_skh	Religion, Sikh, percentage of population in private households	-2	-14	4	0	-1	4	-4
rl_cth	Religion, Catholic, percentage of population in private households	3	85 *	-4	-1	0	4	4
rl_mrm	Religion, Latter Day Saints, percentage of population in private households	-4	-1	-1	0	1	1	-1
rl_jwt	Religion, Jehovah's Witness, percentage of population in private households	-4	-1	-1	-2	-1	1	-1
rl_och	Religion, All other Christian Traditions, percentage of population in private households	-22	-15	-7	-14	-4	-1	-9
rl_ind	Religion, Traditional (North American Indigenous) Spirituality, percentage of population in private households	-2	1	-2	2	0	-2	-2
rl_oth	Religion, Other religions and spiritual traditions, percentage of population in private households	4	-3	1	9	6	0	-2
h_own	Share of private households in owner occupied units	-37	-1	-14	-5	-18	-10	0
h_rnt	Share of private households in renter occupied units	2	0	11	4	19	9	1
h_cnd	Share of private households in condominiums	-49 *	4	7	9	9	2	0
h_p60	Share of occupied private housing units built before 1960	9	4	-4	0	-6	6	5
h_p21	Share of occupied private housing units built 2016-2021	3	-4	23	0	24	1	5
V4132	Housing-Total Sex/Total-Owner households in non-farm, non-reserve private dwellings-25% sample data/% of owner households with a mortgage	-30	2	-11	5	2	-6	12
h_cst	Share owners and tenants spending 30 percent or more of income on shelter	1	3	-3	5	2	-1	1
h_sfm	Share of occupied private dwellings that are single-detached houses	16	-16	-6	-7	-9	-4	-11
h_apl	Share of occupied private dwellings that are apartments <5 stories	-7	8	0	3	-2	1	1
h_aph	Share of occupied private dwellings that are apartments 5+ stories	16	-2	4	5	17	21	-1
h_mob	Share of occupied private dwellings that are movable dwellings	-1	-2	-1	-1	-1	1	0
jt_dr	Commute as driver of car, truck or van, as share of employed labor force	-30	-7	-18	-1	-11	1	-6
jt_tr	Commute by public transit, as share of employed labor force	27	36	21	1	1	3	16
jt_ld	Commute time over 1 hour, as share of employed labor force	-2	4	7	-2	-3	3	2

Printed values are multiplied by 100 and rounded to the nearest integer. Values greater than 0.4 are flagged by an '*'.

Fig. 2 Data of factorial analysis

The data for this study is cited from a factor analysis conducted by Prof. Elvin on the 2021 Statistics Canada population data. It is based on Statistics Canada's 2021 census data for the metro Vancouver area covering a wide range of information including economic, livelihood, and identity. Specifically,

the dataset includes the following contents: family situation, working situation, migration situation, ethnic situation, religion situation, housing situation, and commute situation.

2.4. Geographic information system

In terms of data visualization, this study will use a geographic information system to complete a map of urban mosaic. First, it will create a thematic map for each factor set. The selected cluster of factors will be symbolized, the map will be color-coded based on the factor correlation score and classified by standard deviation intervals. Values that are 2.5 standard deviations above the mean in the standard deviation interval will be retained and defined as significant value in the study. Finally, multiple significant values will be combined to create a composite urban mosaic map (Fig.3).
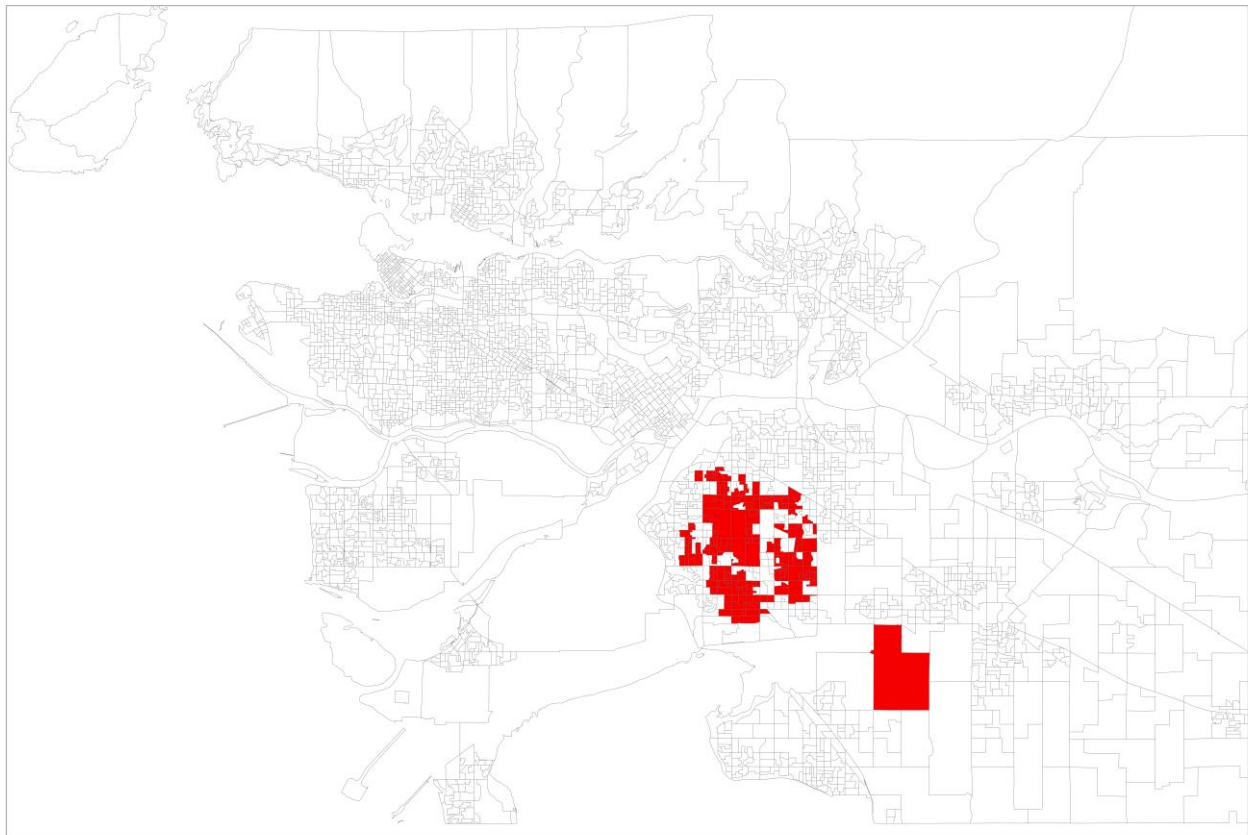
Fig. 3 Map of factor 1

3. Research results

3.1. The visualization of Immigration

Because of the large number of overlapping factors, I separated metro Vancouver's last five years of immigrants from within B.C., interprovincial immigrants, and overseas immigrants from the urban mosaic map to analyze. In the map, provincial immigrants are concentrated in the southern part of Vancouver West (including Marpole, South Granvile, South Cambie, South Vancouver), and the northern part of Vancouver East (including Hastings Sunrise, Renfrew). Interprovincial migrants show a more decentralized distribution than the relatively clustered distribution of intraprovincial migrants. They are widely distributed in Vancouver, West Vancouver, North Vancouver, White Rock, Delta, Coquitlam, Maple Ridge, and Langley. External migrants, however, mainly distributed in Downtown Vancouver& the north part of Vancouver West (including Kitsilano and Fairview). Also,

it shows distribution trends in West Vancouver, around UBC, New Westminster, etc. One notable point is in White Rock, where there are significant concentrations of all three types of immigrants (Fig.4).

Map of Migration in 5 years
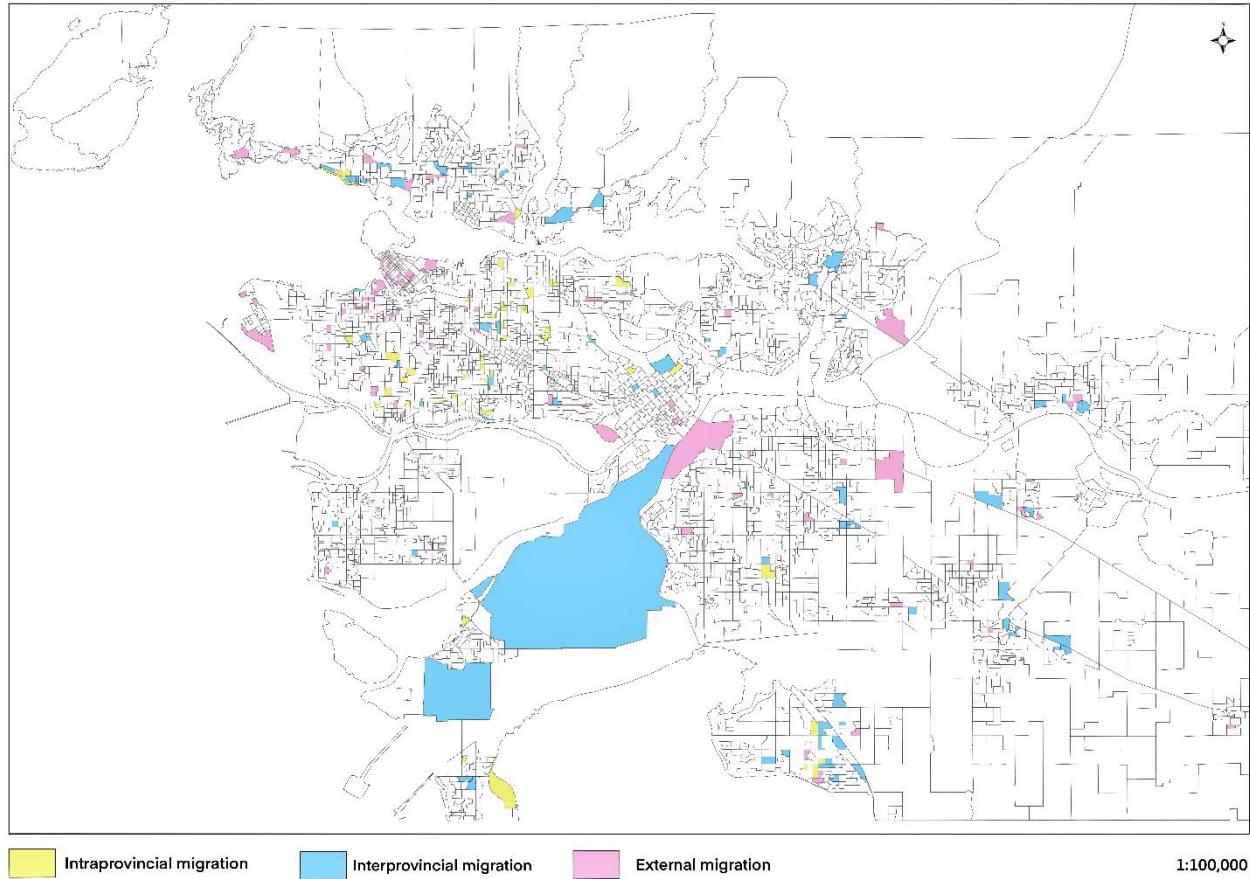
Fig. 4 Map of migration in 5 years

3.2. The visualization of Urban Mosaic

The map of urban mosaic is the core part of this study in terms of visualization (Fig.5). It selects eight factors that are significantly correlated in the factor analysis and exhibit clustering in the spatial autocorrelation of the Metro Vancouver. In the urban mosaic map, the red color is the result of a multitude of factors dominated by South Asian immigrants, including multi-generation household composition, the majority of immigrants landing after 1980 as family immigrants, a predominantly religion of Sikh and Hindu, and a strong correlation with people working in the transportation and warehousing industries. The red colored blocks are concentrated in Surrey (especially Newton) and Campbell heights in the southwest of Langley. The yellow color block is made up of another set of related factors, including Chinese visibility minority, economic immigrants, immigrants from 1980-2000, and Buddhist religion. The yellow color blocks are more sporadically distributed than the strong aggregation of the red color blocks They are scattered throughout Vancouver, concentrating on the Brentwood and Metrotown areas in Burnaby, the northern part of Richmond, Park Royal and its northern part in West Vancouver, as well as the western part of Surrey, Port Moody, Coquitlam, Maple Ridge, and the northern part of Vancouver. There are also significant distributions in western Surrey, Port Moody, Coquitlam, Maple Ridge, and other areas. Regarding the dark green color block, it mainly represents immigrants from West Asia, Muslims, Arabs. It has three significantly clustered areas in the map. The first is in Vancouver East, the second is in the Whalley community in the north part of Surrey, and the third cluster is in Langley Township. The light green color block represents

economic migrants from 2001-2015 who completed their post-secondary education in Asia. Their most notable distribution is clustered in West Vancouver, another point of significance is in Downtown Vancouver, where light green color blocks occur along the coastal strip west of the waterfront as well as along the coast in Yaletown. In addition to migration, some of the lifestyles of the residents appear as notable sets of factors in the figure. The light blue color represents people who work from home, are engaged in technological and cultural occupations, and have a postsecondary education. They are most predominantly clustered in Richmond, with additional clusters in south part of Vancouver West, south part of Vancouver East, south part of Burnaby, and Coquitlam. In addition to the obvious clusters, there are also distributions around UBC, West Vancouver, Surrey, White Rock. The purple color block represents being single, renting a housing unit, and commuting by public transportation. They have more clusters, mainly in Downtown Vancouver's West End neighborhood, Vancouver's Strathcona, Mount Pleasant East, Hastings, Kitsilano, Fairview, False Creek, Marpole, and North Vancouver's Lonsdale neighborhood as well as Maple Ridge and Langley. Regarding the brown color block, it represents people who have never married and live in private homes built before 1960. They are significant concentrations in North Vancouver, the northern part of Vancouver East, New Westminster and the northwest part of Surrey. The gray blocks are for those who are widowed, immigrated before 1980 and do not own property. They are much more sparsely clustered, occurring primarily in the South Vancouver community and South Marine community in Vancouver West.
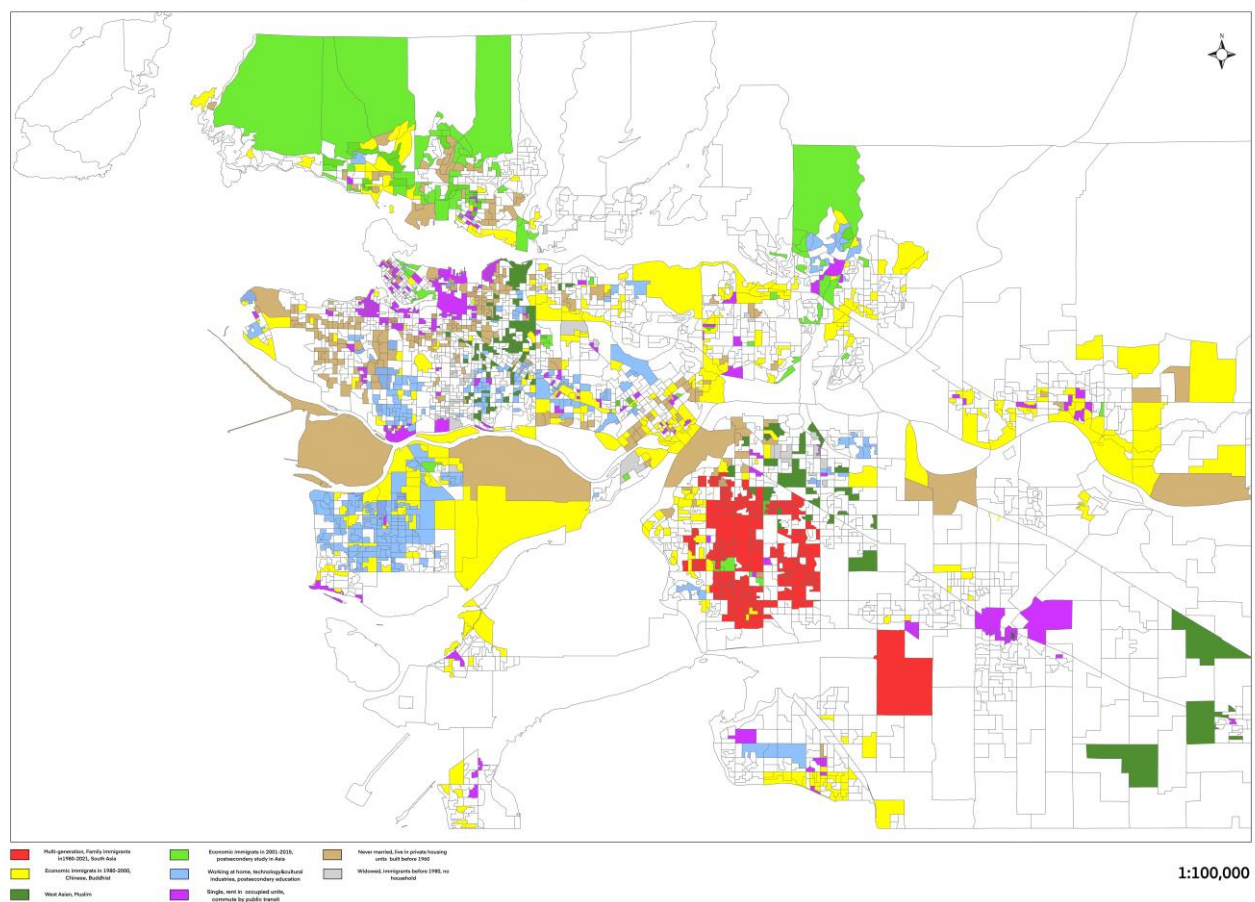
Fig. 5 Map of urban mosaic

3.3. Immigrants from Asia

According to the urban mosaic map, one obvious feature is Vancouver's diverse immigrants. Vancouver's immigrants come from all over the world and represent a variety of cultural and linguistic

backgrounds. Based on data from the 2001 census, Asia has always been a major source of immigrants to Vancouver. Seven of the top ten places of origin for immigrants are Asian countries, and they account for 70% of all immigrants.Among Asian immigrants, Chinese immigrants have always been majority. Among Asian immigrants, Chinese immigrants have always been one of the most important. Chinese immigrants began arriving in British Columbia from California during the gold rush of the 1850s, and more Chinese laborers were recruited during the construction of the Canadian Pacific Railway in the 1880s. From the time they arrived in Vancouver, these Chinese immigrants were severely restricted geographically [7]. Downtown Vancouver's Chinatown in the east was not only a gathering place for Chinese immigrants, but also a spatial boundary of segregation. In such a border area, social order is unstable with frequent violence. After 1945, official external pressure on Chinatown gradually disappeared, and Chinese immigrants moved partly into working-class East Vancouver and partly into middle-class Oakridge [8]. By the 1960s, commercial and trade ties in the Pacific Rim had gradually increased, and Vancouver gradually became an important gateway for Canada to connect with the Asia-Pacific region. The beautiful environment, well-developed medical and education systems have also made it an ideal place for Asian immigrants. From 1986 onwards, immigrants from Hong Kong surged due to the signing of the Sino-British Joint Declaration and the Canadian government's welcome signal. This trend peaked in 1994 and then declined sharply. Most of the Hong Kong immigrants during this period were middle class and came to Vancouver to settle through economic immigration by selling their Hong Kong properties. At the end of the tide of emigration from Hong Kong, the tide of emigration from mainland China began to rise. As of 2001, immigrants from the People's Republic of China in the city of Vancouver and Burnaby outnumbered those from Hong Kong. From 2001 to 2021, immigrants from mainland China became the mainstream of Chinese immigrants in Vancouver. Although Chinese immigrants in the 1980s and 2000s initially gathered more in Richmond and Metrotown in Burnaby, their place of residence has also changed in the past 20 years. According to the Urban Mosaic map, their distribution is more scattered. New Westminster, Coquitlam, Maple Ridge, and the surrounding areas of schools such as UBC and SFU have also seen a concentration of Chinese immigrants. At the same time, although statistical results show that most Chinese immigrants do not have religious beliefs, there is still a high correlation with Buddhism. When the perspective is focused on West Vancouver, economic immigrants from Asia from 2001 to 2015 dominate although there are also yellow and brown blocks interspersed there. Highly educated economic migrants from Asia have taken over the high-end real estate market in West Vancouver and kept overall property prices high. In West Vancouver, the widespread purple blocks have disappeared that there are almost no singles who commute by public transportation and rent condos here.

South Asian immigrants, as another mainstream immigrant group, are clearly concentrated in Surrey. The red blocks represent the first factors selected in the factorial analysis, which have the strongest correlations. They include multiple generations living together, family migration, migration time 1980-2021, South Asian origin, Sikhism, and Hinduism. Early South Asian immigrants to metro Vancouver were mainly Sikhs from the Punjab province. In 1897, the first Indians landed on the coast of British Columbia and found work in the resource industry. The subsequent Pan-Asian Act restricted South Asian immigration until, since the late 1990s, some 25,000 to 30,000 Indians have arrived in Canada each year, making Indians the second largest group of immigrants to Canada after Chinese immigrants. In addition to South Asian immigrants, Surrey is also a destination for Chinese immigrants and some West Asian immigrants that a large number of new immigrants from various ethnic groups have arrived in this booming city. However, Surrey, as the "edge of the suburbs" of Vancouver like Richmond, is bound to be impacted in housing market by the influx of immigrants. Many new immigrants here spend more than half of their monthly household income on housing, they still face problems such as overcrowding and poor housing quality [9]. Apart from that, Urban Mosaic map showing that there is no strict spatial segregation of living spaces between the multi-ethnic immigrants in Surrey. The blocks are interlocked with each other, and a community also houses many new immigrants of different ethnicities. This contributes to interracial dialogue and cultural diversity among the ethnic minorities in the region.

3.4. Gentrification in Vancouver

Gentrification in Vancouver has been a serious situation. Within Metro Vancouver, multiple communities have experienced extensive gentrification. In the City of Vancouver, Downtown Eastside and Chinatown are typical gentrified areas. Many dining, entertainment and fashion industries have settled in. Commercial investment continues to push east, pushing low-income and marginalized people further and further east [5]. The dilapidated shops have been transformed into new upscale retro restaurants, and modern apartments cover the abandoned streets. Gentrification usually occurs in places close to city centers or transportation hubs, with historical and cultural heritage, and in areas with low real estate prices [9].Different social and geographical conditions will attract different groups of people. Places close to city centers or transportation hubs will attract young people with high demand for commuting to work due to their convenience and reduced commuting time. Areas with unique cultural landscapes and historical buildings will attract middle-class people pursuing aesthetics. Communities with strong artistic creativity will attract more artists and designers. Tourist attractions will also attract surrounding vacation rentals and tourism businesses. However, in the process of gentrification, the value of real estate in depressed areas has always been the main driving force for real estate developers. In the Urban Mosaic map, singles commuting to work via public transport and renting in residential units are one of the main customer groups for gentrification. They are the main consumers of commercial goods after the gentrification of the community and the biggest demanders of apartment dwellings. Combining the Urban Mosaic Map and the Migration Map reveals that the Marpole neighborhood is an area where purple blocks overlap with areas with a high propensity to migrate [10]. Similarly, the Sunrising neighborhood is home to a dense concentration of purple and brown blocks. These low-rent areas where young people gather are areas where gentrification is likely to occur in the future. Although the Kitsilano neighborhood is also densely packed with purple blocks and has a high tendency to immigrate, it is difficult to undergo large-scale gentrification because it is already a high-end neighborhood with a wealth of businesses a couple of decades ago.

3.5. Work from home after the pandemic

Since the pandemic in 2019, online working has become popular and is thriving in the financial, technology, and cultural industries, with more and more people demanding to work from home [11] . These people gather in the light blue patches in the Urban Mosaic map, including Richmond, various communities in the south of Vancouver, the southern part of Burnaby near Metrotown, Coquitlam, and the northeast part of Surrey. The reasons for attracting people who work from home are complex. One situation is that the industries in which the people who happen to live here are engaged can support online work. In addition, lower housing prices, a more beautiful environment, and the development of surrounding businesses are all related. Although the factors behind this remain to be analyzed, these gathering areas may have higher potential for food delivery, fitness center and residential peripheral businesses.

4. Conclusion

The study provides a method for forming and visualizing autocorrelated data sets from raw statistical data, but there is still a gap with the well-developed Urban Mosaic map due to the limitations of census data and geographic segmentation. Similarly, many identity characteristics are not clearly shown. For example, within South Asian migrants, there are different identities between Sikh and Indian migrants, but they are merged into red blocks in the map.

Overall, the study shows that objectively Vancouver's immigrants of different ethnicities have unique characteristics and existing spatial separation, although there is no forced segregation from the outside. People with similar lifestyles also congregate neighborhoods. Those gatherings are more internally driven and spontaneous than geographically segregated in the traditional sense, and the urban identity of the citizens within the city is also influenced by those gatherings. Urban mosaics effectively

capture these spatial gatherings, illustrating how various factors (such as ethnicity, occupation and housing) shape the distribution of different communities. It highlights the impact of changes such as the spatial concentration of different migrant groups, the development of gentrification, and the rise of remote work in the wake of the COVID-19 pandemic on the urban structure. Limited by the diversity of census data, there are more unexplored factors that shape the spatial characteristics of cities to be explored. The study confirms that the methods of factorial analysis and urban mosaic can be effectively used to identify the spatial characteristics of metro Vancouver and can be further applied to urban policy formulation and land development planning.

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