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表1. 基本特性

	対象者全員 (N=3237)	男性 (N=1455)	女性 (N=1782)
年齢(歳)			
25-29歳	396 (12)	150 (10)	246 (14)
30-34歳	404 (12)	176 (12)	228 (13)
35-39歳	447 (14)	174 (12)	273 (15)
40-44歳	438 (14)	209 (14)	229 (13)
45-49歳	380 (12)	160 (11)	220 (12)
50-54歳	349 (11)	175 (12)	174 (10)
55-59歳	330 (10)	161 (11)	169 (9)
60-64歳	493 (15)	250 (17)	243 (14)
学歴			
中学校	215 (7)	130 (9)	85 (5)
高等学校	1198 (37)	526 (36)	672 (38)
専修学校	464 (14)	170 (12)	294 (17)
短期大学・高等専門学校(5年制)	405 (13)	44 (3)	361 (20)
大学・大学院	949 (29)	581 (40)	368 (21)
わからない・未記入	6	4	2
過去1年間の世帯収入(万円)			
なし	40 (2)	26 (2)	14 (1)
< 60	44 (2)	24 (2)	20 (1)
60-119	86 (3)	39 (3)	47 (3)
120-179	128 (5)	51 (4)	77 (6)
180-239	226 (9)	78 (7)	148 (11)
240-299	315 (13)	136 (12)	179 (13)
300-359	266 (11)	106 (9)	160 (12)
360-479	346 (14)	168 (15)	178 (13)
480-719	566 (23)	266 (23)	300 (22)
720-959	275 (11)	136 (12)	139 (10)
≥ 960	222 (9)	115 (10)	107 (8)
わからない・未記入	723	310	413
加入健康保険			
共済組合	189 (6)	83 (6)	106 (6)
組合健保	963 (30)	422 (29)	541 (30)
協会けんぽ	638 (20)	281 (19)	357 (20)
国民健康保険	1242 (38)	551 (38)	691 (39)
生活保護	115 (4)	71 (5)	44 (2)
その他	84 (3)	43 (3)	41 (2)
未記入	6	4	2
居住地の地区類型			
専門管理	559 (17)	255 (18)	304 (17)
ミドル	1332 (41)	610 (42)	722 (41)
ブルー	953 (29)	408 (28)	545 (31)
失業非正規	393 (12)	182 (13)	211 (12)

表中の数値はn (%)。

表2. 肝疾患の既往歴・家族歴、および肝炎ウイルス感染のハイリスクと考えられる機会に関する特性

	対象者全員 (N=3237)	男性 (N=1455)	女性 (N=1782)
肝疾患の既往歴			
なし	3055 (95)	1342 (92)	1713 (96)
あり	176 (5)	110 (8)	66 (4)
未記入	6	3	3
肝疾患の家族歴			
なし	2758 (85)	1258 (87)	1500 (84)
あり	473 (15)	194 (13)	279 (16)
未記入	6	3	3
輸血歴 [a]			
なし	3126 (97)	1398 (96)	1728 (97)
あり	102 (3)	51 (4)	51 (3)
未記入	9	6	3
手術歴 [a]			
なし	2732 (85)	1242 (86)	1490 (84)
あり	475 (15)	199 (14)	276 (16)
未記入	30	14	16
血液透析歴 [a]			
なし	3226 (100)	1451 (100)	1775 (100)
あり	3 (0)	1 (0)	2 (0)
未記入	8	3	5
非加熱血液凝固因子製剤の投与歴 [a]			
なし	3222 (100)	1449 (100)	1773 (100)
あり	6 (0)	3 (0)	3 (0)
未記入	9	3	6
フィブリノゲン製剤の投与歴 [a]			
なし	3221 (100)	1448 (100)	1773 (100)
あり	3 (0)	1 (0)	2 (0)
未記入	13	6	7
刺青の経験			
なし	3174 (98)	1438 (99)	1736 (98)
あり	60 (2)	16 (1)	44 (2)
未記入	3	1	2
耳ピアスの経験			
なし	2259 (70)	1330 (91)	929 (52)
あり	976 (30)	124 (9)	852 (48)
未記入	2	1	1
ボディピアスの経験			
なし	3186 (99)	1445 (99)	1741 (98)
あり	47 (1)	8 (1)	39 (2)
未記入	4	2	2

表中の数値はn (%)。

[a] 1990年より前の既往のみ考慮。

	対象者全員			男性			女性		
	n/N	(%)	推定受検者数[a]	n/N	(%)	推定受検者数[a]	n/N	(%)	推定受検者数[a]
B型肝炎ウイルス検査受検あり									
25-29歳	59/396	(15)	28,166	7/150	(5)	4,614	52/246	(21)	20,054
30-34歳	84/404	(21)	40,918	11/176	(6)	5,769	73/228	(32)	31,581
35-39歳	117/447	(26)	56,884	17/174	(10)	10,938	100/273	(37)	40,481
40-44歳	88/438	(20)	38,752	22/209	(11)	10,625	66/229	(29)	28,180
45-49歳	103/380	(27)	45,530	24/160	(15)	12,662	79/220	(36)	30,318
50-54歳	93/349	(27)	39,134	35/175	(20)	14,637	58/174	(33)	23,679
55-59歳	73/330	(22)	35,676	31/161	(19)	15,844	42/169	(25)	19,694
60-64歳	101/493	(20)	40,471	45/250	(18)	18,541	56/243	(23)	22,851
計	718/3237	(22)	324,116	192/1455	(13)	95,990	526/1782	(30)	220,460
40-64歳(再掲)	458/1990	(23)	200,525	157/955	(16)	70,493	301/1035	(29)	125,068
C型肝炎ウイルス検査受検あり									
25-29歳	27/396	(7)	13,144	4/150	(3)	2,768	23/246	(9)	8,595
30-34歳	54/404	(13)	25,330	13/176	(7)	6,731	41/228	(18)	17,765
35-39歳	63/447	(14)	30,630	15/174	(9)	9,844	48/273	(18)	19,693
40-44歳	61/438	(14)	27,127	21/209	(10)	9,659	40/229	(17)	16,519
45-49歳	72/380	(19)	32,040	22/160	(14)	11,818	50/220	(23)	19,370
50-54歳	72/349	(21)	30,437	31/175	(18)	13,173	41/174	(24)	17,221
55-59歳	63/330	(19)	30,811	23/161	(14)	11,674	40/169	(24)	18,906
60-64歳	88/493	(18)	36,424	42/250	(17)	17,511	46/243	(19)	18,877
計	500/3237	(15)	220,988	171/1455	(12)	88,607	329/1782	(18)	132,276
40-64歳(再掲)	356/1990	(18)	156,933	139/955	(15)	66,087	217/1035	(21)	90,566
B型、C型肝炎ウイルス検査ともに受検あり									
25-29歳	24/396	(6)	11,266	4/150	(3)	2,768	20/246	(8)	7,640
30-34歳	50/404	(12)	23,382	10/176	(6)	5,769	40/228	(18)	17,765
35-39歳	53/447	(12)	26,254	12/174	(7)	7,656	41/273	(15)	16,411
40-44歳	52/438	(12)	23,251	17/209	(8)	7,727	35/229	(15)	14,576
45-49歳	64/380	(17)	28,667	19/160	(12)	10,130	45/220	(20)	16,844
50-54歳	59/349	(17)	24,640	27/175	(15)	10,978	32/174	(18)	12,916
55-59歳	47/330	(14)	22,703	19/161	(12)	10,007	28/169	(17)	13,392
60-64歳	66/493	(13)	26,306	31/250	(12)	12,360	35/243	(14)	13,909
計	415/3237	(13)	191,523	139/1455	(10)	73,839	276/1782	(15)	110,230
40-64歳(再掲)	288/1990	(14)	122,059	113/955	(12)	52,870	175/1035	(17)	73,316

[a] 平成22年度の国勢調査による大阪市の性・年齢階級別人口に基づき計算。

表4. 肝炎ウイルス検査受検の機会

	25-64歳			40-64歳		
	対象者全員 n (%)	男性 n (%)	女性 n (%)	対象者全員 n (%)	男性 n (%)	女性 n (%)
B型肝炎ウイルス検査受検あり	*N=718*	*N=192*	*N=526*	*N=458*	*N=157*	*N=301*
市区町村(取り扱い医療機関を含む)が行っている肝炎ウイルス検査	81 (11)	22 (11)	59 (11)	75 (16)	20 (13)	55 (18)
会社や健康保険組合等が行っている肝炎ウイルス検査(人間ドックも含む)	223 (31)	73 (38)	150 (29)	147 (32)	60 (38)	87 (29)
病気の検査、治療、経過観察などのため、医療機関で受けた肝炎ウイルス検査	182 (25)	72 (38)	110 (21)	139 (30)	62 (39)	77 (26)
献血した時	72 (10)	35 (18)	37 (7)	41 (9)	24 (15)	17 (6)
妊婦健診の時	240 (33)	—	240 (46)	107 (23)	—	107 (36)
その他	8 (1)	2 (1)	6 (1)	6 (1)	2 (1)	4 (1)
C型肝炎ウイルス検査受検あり	*N=500*	*N=171*	*N=329*	*N=356*	*N=139*	*N=217*
市区町村(取り扱い医療機関を含む)が行っている肝炎ウイルス検査	76 (15)	20 (12)	56 (17)	73 (21)	19 (14)	54 (25)
会社や健康保険組合等が行っている肝炎ウイルス検査(人間ドックも含む)	185 (37)	60 (35)	125 (38)	122 (34)	47 (34)	75 (35)
病気の検査、治療、経過観察などのため、医療機関で受けた肝炎ウイルス検査	178 (36)	73 (43)	105 (32)	137 (38)	64 (46)	73 (34)
献血した時	70 (14)	27 (16)	43 (13)	38 (11)	18 (13)	20 (9)
その他	26 (5)	1 (1)	25 (8)	9 (3)	0 (0)	9 (4)

複数回答のため、表中の%の合計は100とならない。

表5.「B型、C型肝炎ウイルス検査ともに受検あり」に関連する因子

		25-64歳			25-39歳	40-64歳
	n/N (%)	Crude model	Adjusted model 1 [a]	Adjusted model 2 [b]	Adjusted model 2 [b]	Adjusted model 2 [b]
		OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
性						
男性	139/1455 (10)	1.00	1.00	1.00	1.00	1.00
女性	276/1782 (15)	1.74 (1.40-2.16)	1.80 (1.39-2.33)	1.79 (1.38-2.32)	2.61 (1.57-4.34)	1.52 (1.11-2.07)
年齢						
25-39歳	127/1247 (10)	1.00	1.00	1.00		
40-64歳	288/1990 (14)	1.49 (1.20-1.86)	1.48 (1.15-1.91)	1.48 (1.14-1.90)		
肝疾患の既往歴						
なし	360/3055 (12)	1.00	1.00	1.00	1.00	1.00
あり	54/176 (31)	3.31 (2.36-4.65)	3.48 (2.41-5.04)	3.46 (2.39-5.00)	2.48 (0.83-7.43)	3.42 (2.31-5.07)
未記入	1/6					
肝疾患の家族歴						
なし	318/2758 (12)	1.00	1.00	1.00	1.00	1.00
あり	97/473 (21)	1.98 (1.54-2.55)	1.65 (1.26-2.15)	1.65 (1.27-2.15)	1.69 (0.97-2.95)	1.66 (1.22-2.24)
未記入	0/6					
感染のハイリスクと考えられる機会(医療行為) [c]						
なし	320/2691 (12)	1.00	1.00	1.00	1.00	1.00
あり	88/515 (17)	1.53 (1.18-1.98)	1.29 (0.98-1.70)	1.29 (0.98-1.69)	0.88 (0.39-2.03)	1.36 (1.01-1.82)
未記入	7/31					
感染のハイリスクと考えられる機会(その他) [d]						
なし	282/2244 (13)	1.00	1.00	1.00	1.00	1.00
あり	133/991 (13)	1.08 (0.86-1.35)	0.98 (0.75-1.27)	0.98 (0.75-1.27)	0.84 (0.55-1.28)	1.06 (0.75-1.49)
未記入	0/2					
学歴						
大学・大学院	122/949 (13)	1.00	1.00	1.00	1.00	1.00
専修学校・短期大学・高等専門学校(5年制)	157/869 (18)	1.50 (1.16-1.93)	1.21 (0.91-1.60)	1.23 (0.93-1.63)	1.47 (0.95-2.27)	1.15 (0.80-1.67)
高等学校	122/1198 (10)	0.77 (0.59-1.00)	0.61 (0.46-0.81)	0.62 (0.46-0.83)	0.45 (0.24-0.83)	0.66 (0.47-0.94)
中学校	13/215 (6)	0.44 (0.24-0.79)	0.33 (0.17-0.62)	0.34 (0.18-0.64)	0.70 (0.13-3.78)	0.29 (0.14-0.60)
わからない・未記入	1/6					
加入健康保険						
共済組合	32/189 (17)	1.00	1.00	1.00	1.00	1.00
組合健保	120/963 (12)	0.70 (0.46-1.07)	0.70 (0.45-1.08)	0.70 (0.45-1.08)	0.68 (0.34-1.35)	0.75 (0.42-1.34)
協会けんぽ	101/638 (16)	0.92 (0.60-1.43)	0.93 (0.60-1.46)	0.93 (0.59-1.46)	0.97 (0.47-2.00)	0.96 (0.54-1.73)
国民健康保険	136/1242 (11)	0.60 (0.40-0.92)	0.65 (0.42-1.01)	0.65 (0.42-1.00)	0.37 (0.19-0.76)	0.86 (0.49-1.53)
生活保護	16/115 (14)	0.79 (0.41-1.52)	0.88 (0.43-1.79)	0.88 (0.43-1.79)	1.31 (0.32-5.33)	0.84 (0.36-1.97)
その他	10/84 (12)	0.66 (0.31-1.42)	0.61 (0.26-1.41)	0.60 (0.26-1.41)	0.71 (0.20-2.44)	0.53 (0.17-1.72)
未記入	0/6					
居住地の地区類型						
専門管理	88/559 (16)	1.00		1.00	1.00	1.00
ミドル	159/1332 (12)	0.73 (0.55-0.96)		0.77 (0.58-1.03)	0.67 (0.40-1.12)	0.81 (0.57-1.16)
ブルー	120/953 (13)	0.77 (0.57-1.04)		0.82 (0.60-1.12)	0.88 (0.51-1.52)	0.79 (0.53-1.16)
失業非正規	48/393 (12)	0.75 (0.51-1.09)		0.79 (0.53-1.17)	0.52 (0.25-1.08)	0.96 (0.59-1.54)

OR:オッズ比、CI:信頼区間。

[a] 説明変数:性、年齢、肝疾患の既往歴、肝疾患の家族歴、感染のハイリスクと考えられる機会(医療行為)、感染のハイリスクと考えられる機会(その他)、学歴、加入健康保険。

[b] 説明変数:Adjusted model 1 に含めた変数 + 居住地の地区類型。ただし、層化解析ではモデルに年齢を含めず。

[c] 輸血、手術、血液透析、非加熱血液凝固因子製剤の投与、フィブリノゲン製剤の投与の各既往のうち、1990年より前に受けたもの。

[d] 刺青、耳ピアス、ボディピアスの各経験(時期にかかわらず)。

分担研究報告書

4 居住地に由来する差別の健康影響に関する研究

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研究要旨

背景：居住地に由来する差別を受けた個人が健康を害する事例が報告されてきているが、組織化された（地域に組み込まれた；institutionalized）かたちでの居住地に由来する差別というものがどのように健康に関連しているのかについての研究報告はほとんど実施されていない。

研究方法：大阪市の町字100地点から25から64歳の男女6191人を二段ランダム抽出により対象者として選択し、横断調査を2011年に実施した。3244人の有効回答者のうち、選択条件に適合した2963人が本研究の解析対象者である。社会経済的要因等の個人レベル要因を調整し、個人レベルならびに地域レベル（institutionalized）の居住地に由来する差別と主観的健康感の関連をマルチレベルロジスティック回帰分析により検討した。地域レベルの居住地由来差別変数は各町字における個人レベルの居住地由来差別体験の有無の割合として計算された（4分位として使用）。地域レベル居住地由来差別変数と健康との関連について地域レベルの社会経済的要因変数（失業者割合等；4分位として使用）と比較した。

研究結果：個人レベルの居住地由来差別の調整後、最も居住地由来差別の多い地域（4分位）は最も少ない地域と比較して主観的健康感が悪い（不健康）ことに対するオッズ比が1.57（95%信頼区間: 1.13-2.18）と有意に高かった。さらに社会経済的要因（失業、持ち家の有無、学歴）を調整したモデルにおいては、最も居住地由来差別の多い地域は$p<0.1$水準で有意に不健康が多かった。一方、同モデルにおいて地域レベルの持ち家率や社会的剥奪指数（deprivation index）は不健康に対して有意な結果を示さなかった。さらに社会的紐帯（配偶者の有無、友人数；social relationship）を調整したモデルでは、地域レベルの居住地由来差別は有意差を示さなかったが、個人レベルの居住地由来差別体験は有意に不健康と関連していた。（オッズ比1.96 [1.29-2.92]）

まとめ：組織化された居住地由来差別は社会的剥奪指標等の地域レベルの社会経済的要因変数よりも主観的健康感の重要な環境的決定要因なのかもしれない。組織化された居住地由来差別の健康影響は個人レベルの居住地由来差別体験よりも小さいものと考えられたが、地域住民の健康改善のためには組織化され地域に組み込まれた居住地由来差別（直接みることが難しい側面）にも注意を払わなければならないだろう。

Title

Individualized and institutionalized residential place-based discrimination and self-rated health in Japan: A cross-sectional study

Abstract

Background

Several studies have reported that individualized residential place-based discrimination (PBD) affects residents' health. However, studies exploring the institutionalized pathway between PBD and health are scarce, especially in Asian countries including Japan.

Methods

A cross-sectional study was conducted with random two-stage sampling of 6191 adults aged 25-64 years in 100 census tracts across Osaka city in 2011. Of 3244 respondents, 2963 were analyzed using multilevel logistic regression to examine the association of both individualized and institutionalized PBD with self-rated health (SRH) after adjustment for individual-level

factors such as socioeconomic status (SES). An area-level PBD indicator (ALPBD) was created by aggregating individual-level PBD responses in each tract, then dividing tracts into quartiles. The health impact of ALPBD was compared with that of area-level SES indicators (quartile) such as unemployment.

Results

After adjustment for individual-level PBD, the highest ALPBD quartile showed significant odds ratio (OR) 1.57 (95% credible interval: 1.13-2.18) for poor SRH compared with the lowest ALPBD quartile. ORs of ALPBD (highest and third quartile) were marginally significant in a further SES-adjusted model, although those of not-home-owner and deprivation index were attenuated and not significant. Individual-level PBD showed significant OR 1.96 (1.29-2.92) for poor SRH in a fully-adjusted model, although ALPBD did not.

Conclusion

Institutionalized PBD may be a more important environmental determinant of SRH than other area-level SES indicators such as deprivation. Although it may have a smaller health impact than individualized PBD, attention should be paid to invisible and unconscious aspects of institutionalized PBD to improve residents' health.

A-E: Introduction

Understanding the impact of place on health is a key element of epidemiologic investigation.[1,2] Various aspects of residential place, such as green space, walkability, social capital, poverty, unemployment and deprivation, have been studied as the environmental determinants of health.[3-9] The concept of an association between place and discrimination such as racial/ethnic residential segregation is also one of the most investigated research fields in the USA.[10,11] However, study based of this concept outside the USA is scarce, especially in Asian countries. On the other hand, the concept of discrimination due to geographical place of residence (place-based discrimination; PBD) has been explored as "territorial stigmatization". Within the fields of sociology and geography, this exploration has focused on the bottom level of the hierarchy of place, in areas such as St Paul's (Bristol, UK) and the *banlieues* in France,[12,13] although relatively little attention has been paid to the entire spectrum of population.

In our previous study,[14] we reported that interpersonal perceived PBD, such as *Buraku* or *Nishinari* discrimination,[15,16] was associated with poor mental health in a stigmatized area in Osaka, Japan (see also supplementary introduction). However, this previous study treated only the individual-level perceived discrimination (individualized pathway), which is unlikely to capture the full complexity of PBD.[17] It is therefore important, when considering the mechanisms between PBD and health, that both individualized and institutionalized pathways are taken into account.[18,19] PBD may not be merely the actions and prejudices of individuals against individuals; institutionalized PBD may be perpetuated by organizations and represent processes built into social entities, in a similar way to institutionalized racism.[19] Thus, even if residents do not recognize the existence of interpersonal PBD, they may suffer inherent institutionalized PBD and, in turn, their health may be compromised. Our objective was to examine the association of both individualized and institutionalized PBD

with health, using the self-rated health (SRH) index, in a range of individuals from the whole Osaka city population. We focused on area-level contextual effects on health, comparing the health impact of institutionalized PBD with that of other area-level indicators relating to socioeconomic status (SES), after adjusting for individual-level factors including perceived PBD, SES and social relationships.

Methods

Study participants

A cross-sectional study was conducted from September to November 2011 in Osaka, a city with a population of 2.7 million.[20] We randomly selected 100 of the 1759 census enumeration tracts (each tract has average of 1500 inhabitants) of the city, and randomly sampled 63 adults in each tract. After excluding inhabitants who had recently migrated (had an address outside the selected tracts), 6191 adults aged 25-64 years as of August 1, 2011 were systematically selected. Self-administered questionnaires were distributed and collected by mail. We visited non-responders at least three times with at least one visit on a weekend or in the evening. For data quality control, missing or inconsistent answers were re-tested by telephone. 3244 subjects were available and provided written consent, giving a response rate of 52.4%. The study was approved by the Ethics Committee of Osaka City University.

Outcome variable

The outcome variable was poor SRH. The value of measuring SRH as a predictor of mortality risk has been extensively reported.[21] SRH was measured through the question "In general, what is your current health status: excellent, very good, good, fair or poor?" For analysis purposes, this variable was dichotomized according to the previous studies[22,23] as good ("excellent/very good/good") and poor ("fair/poor"). SRH primarily captures physical health and, to some extent, mental health.[24]

Individual-level PBD

Participants were asked the following question to measure their individual-level perceived PBD: "how often have you suffered discrimination based on geographical place of residence in your social life? (frequently, sometimes or never)" This variable was dichotomized into yes (frequently and sometimes) and no (never).

Area (tract)-level indicators

Six characteristics of place (tract) were measured by two methods. First, area-level aggregates of survey responses were used to characterize neighborhoods, as participants in each neighborhood are viewed as informants of the conditions in their area;[25] and second, Japanese census 2005 based measures. An area-level PBD (ALPBD) indicator was created by aggregating individual-level perceived PBD response among each tract, representing a proxy for institutionalized PBD, i.e., the concept that living in a stigmatized neighborhood affects neighborhood health. The percentage of unemployed residents and the percentage of those who did not own their own house (according to both methods) were also used as area-level SES indicators, because these factors were considered as representative social determinants of health.[9,26] The sixth area-level indicator was an area-level deprivation index (ALDI), which was constructed using the census 2005 data for unemployment,

housing tenure, aging and poverty, with an adjusted range of 0 to 100. The details of how to construct this index and how this index showed health disparity in Japan are given elsewhere (see supplementary method).[8] The 100 tracts were divided into quartiles; the higher quartiles represented the more disadvantaged neighborhoods.

Individual-level covariates

The variables included in the adjustment model were age, sex, SES and social relationships. In terms of SES, working status, housing tenure and educational attainment were used. Working status was categorized as "working" or "not working" including "retired", "housewife" and "unemployed". Housing tenure was dichotomized as "home owner by self or household members" or "not". Education attainment was dichotomized as "high school" or "college or more". Social relationships were categorized by "number of friends" and "marital status". "Number of friends" was categorized as "0", "1-4", or "5 or more". Marital status was dichotomized as "married" or "not".

Statistical analyses

Participants who had moved within the previous year (n=263), or had missing mobility data (n=12) or PBD (n=7) were excluded, because recent migration was likely to cause misclassification for ALPBD. The remaining 2963 subjects were analyzed. Each tract included between 14 and 44 subjects (eTable 1). Chi-squared tests were used to compare the difference in subjects' characteristics according to perceived PBD and poor SRH. Basic statistics such as mean, median and Pearson correlation coefficients were calculated for assessing the association between area-level indicators before making quartiles.

Individuals (first-level) were nested in the districts (second-level). The analysis framework anticipated that individual health outcomes would be partly dependent on the districts where individuals live. We therefore used multilevel models to estimate the variation in outcome between districts (random effects) and the effect of area-level indicators on the outcome with adjustment for individual compositional characteristics (fixed effects). Multilevel logistic regression models with random intercepts and fixed slopes using Markov Chain Monte Carlo methods, with chain length 50,000 burn-in 5000,[27] were applied using the MLwiN 2.25 software package (Centre for Multilevel Modeling, University of Bristol, UK). Each area-level characteristic was tested in a separate model because of potential multicollinearity between the area-level indicators.[28] Unadjusted and age and sex-adjusted odds ratios (ORs) and 95% credible intervals (CIs) for poor SRH were calculated (model 1 and 2, respectively). To distinguish the individual-level compositional effect and area-level contextual effect of PBD (or SES) on outcome, a corresponding individual-level PBD (or SES) variable was added into model 3. Additional adjustments for all individual-level PBD and SES were conducted as model 4. Further adjustments for social relationships were applied as a fully-adjusted model (model 5). Probability values for statistical tests were two-tailed and $p < 0.05$ and $p < 0.1$ were considered statistically significant and marginally significant, respectively. Descriptive analyses were performed using SAS version 9.2 (SAS Institute, Cary, NC, USA).

Results

Basic characteristics of the study subjects and the proportions of perceived PBD and

poor SRH are shown in Table 1. Women were more likely to answer "yes" to experiencing PBD than men. A higher proportion of perceived PBD was observed among subjects who were less educated, had no spouse or had friends. The proportion of poor SRH significantly differed for all factors. A higher proportion of poor SRH was observed among subjects who had low SES or low social relationships.

Mean, median, range and correlation among area-based indicators used in this study are shown in Table 2. The mean of ALPBD was 6.9 with a range from 0.0 to 50.0%. ALPBD had moderate correlation with area-level unemployment by census (ALUEC) (0.55) and ALDI (0.63). Two combinations of ALUEC and ALDI, and area-level not-home-owner by aggregated responses (ALNHA) and area-level not-home-owner by census (ALNHC) had an especially high correlation of 0.90 and 0.80, respectively. The distribution of ALPBD was consistent with our a priori knowledge of PBD in areas such as *Buraku* or *Nishinari* except for the second quartile of ALPBD (data not shown).[14]

Table 3 shows the proportions of perceived PBD and poor SRH according to the quartiles of area-level indicators with their ranges. Participants who lived in disadvantaged places (higher quartiles) were more likely to answer "yes" to experiencing PBD. The proportion of poor SRH significantly differed by all area-level indicators except for ALNHC.

Tables 4 and 5 show the results of the multilevel logistic analyses. All analyzed individual-level factors showed significant associations with poor SRH in the fully-adjusted model (model 5). For example, ORs (95%CI) were 1.96 (1.29-2.92), 2.03 (1.33-3.08) and 1.60(1.26-2.04) for perceived PBD, unemployment and not-home-owner, respectively (Table 4).

Regarding associations between area-level indicators and poor SRH (Table 5), only area-level indicators were included in model 1. The ORs for the third and highest quartiles of ALPBD, ALNHA and ALNHC, third quartile of area-level unemployment by aggregated responses (ALUEA), and highest quartile of ALDI were statistically significant compared with the lowest quartile. After adjustment for age, sex and a corresponding individual-level factor (model 3), the ORs for highest quartile of ALPBD, ALNHC and ALDI were attenuated, but remained statistically significant. In the individual-level PBD and SES-adjusted model (model 4), the ORs for the third and highest quartiles of ALPBD were marginally significant: 1.31 (95%CI: 0.93-1.84) and 1.32 (0.95-1.86), respectively. In the fully-adjusted model (model 5), the ORs for ALPBD, ALNHA, ALNHC and ALDI were all non-significant, although the ORs for the third quartile of ALUEC were marginally significant. ORs for the third quartile of ALUEA retained significance throughout all models.

Discussion

Our results showed that not only individualized PBD but also institutionalized PBD might be social determinants of health after individual-level factors such as SES had been taken into account, although the health impact of institutionalized PBD was not fully statistically significant and was lower than that of the individualized PBD. The adverse effect of individual-level PBD on mental health was stronger among the highly educated than among the less educated in our previous study.[14] Health differences between ethnic minorities and

majorities were considerably attenuated after adjustment for perceived discrimination in addition to SES.[29] We, therefore, consider this to be new evidence that discrimination including PBD may affect health independently of SES.

In the individual-level PBD and SES-adjusted model (model 4), the ORs of ALPBD for poor SRH were marginally significant, those of other area-level SES indicators were attenuated (i.e., ALNHC and ALDI) and did not show consistent tendency of quartile order (i.e., ALUEA, ALUEC and ALNHA). The lack of hierarchical association between area-level unemployment and poor health was unexpected, because unemployment is a key social factor in major deprivation indices used worldwide.[6,30,31] Because ALUEA was derived from the proportion of an average of 1.6 unemployed persons, ranging between zero and five, in tracts which consist of an average of 29.6 persons, this might be unstable and biased (eTable 1). The patterning of gradients in health detected by the area-level indicators may reflect both the different meanings of the areas investigated and the different pathways by which diverse aspects of SES (PBD) influence health.[6,32]

Mechanism between PBD and health

Pearce has suggested that, in terms of the mechanism between PBD and health, individualized and institutionalized pathways are mutually non-exclusive.[18] First, deteriorated identity or social relations deriving from internalization of PBD have etiological links, particularly with health related behaviors and mental health. Second, a number of life chances, such as education, training opportunities, employment prospects and developing interpersonal relationships, are harmed by the baggage of "moral inferiority" that is associated with residents of highly stigmatized neighborhoods. Thus, consequential relative material deprivation can harm health due to the psychosocial harm of individuals. Third, highly stigmatized areas suffer from disinvestment in environmental goods such as housing, local infrastructure and services, which destabilizes efforts to sustain the social determinants of health; i.e., environmental injustice affects health.[33] Fourth, not only individual social networks but also neighborhood social bonds and collective efficacy are undermined in highly marginalized hidden neighborhoods in response to perceived threats related to PBD. Last, stigmatized areas have been made historically and economically static, because of migration of the poverty and reproduction of the discrimination, and continued deterioration of residents' health. Although little is known about mechanism between PBD and health, the above mechanism is almost identical to the pathways which have been suggested in the setting of general discrimination, such as racial/ethnic discrimination.[17]

Institutionalized discrimination

According to the above five mechanisms, as the direct effects of interpersonal discrimination are likely to provide only a partial account for the association between PBD and health,[18] PBD must be understood and assessed within what Williams et al. describe as "the larger context of institutionalized discrimination [racism] which has created differential exposure to a broad range of stressors".[34] The institutionalized discrimination due to living in a stigmatized place may be understood as invisible and unconscious exposure such as lack of local environmental investment, suppression of job opportunities and denial

of friendships, which can be associated with deterioration of housing conditions, unemployment and poor social relationships, respectively.[17,35] Thus, key social determinants of health such as unemployment and social relationships might not be confounding factors, but mediated factors, between PBD and health. When only small measures of individual social determinants are adjusted, neighborhood indicators may be more likely to act as proxies for unmeasured individual level information. In general, studies adjusting for more individual level measures of SES found smaller measures of association between area-level SES and health. On the other hand, controlling for individual SES may remove part of the contextual effect.[36] Therefore, with respect to our findings, the impact of institutionalized PBD on health should be evaluated within the range of models 3 and 5. The non-significant result of ALPBD for poor SRH in model 5 might be an underestimation, whereas the statistical significance of ALPBD in model 3 might be an overestimation.

ALPBD may include the traditional spatial pattern in Osaka city,[37] corresponding to the fifth mechanism above.[18] It has long been recognized in sociology, geography and economics that the geographic distribution of households is not random but arises from political, economic, historical, and social processes. Our findings accord with the suggestion put forward by Messer, that the neighborhood-forming process cause differential locations of populations and these populations will share the same influences on their health which, in turn, will lead to geographical clusters.[38]

Consideration for not only the bottom layer of society but also the entire population

By using measures of clustering of individual health status within neighborhoods, we were able to evaluate the importance of the neighborhood-level approach.[39] These considerations are important when attempting to determine an approach on places rather than on individuals. Focusing on a small group in a disadvantaged area may not be an efficient approach as only a small variation in health will be seen and many at-risk people residing outside the disadvantaged area will be ignored.[39] In this study, we focused on the whole range of population in Osaka city and found the association between poor SRH and not only a priori-considered stigmatized areas (the bottom quartile) but also subsequently stigmatized areas (third quartiles of ALPBD). This suggests that not only is a high-risk population approach necessary for the bottom quartile but that an entire population-based strategy would improve population health.[40]

Drawing policy makers' attention

The first step in eliminating PBD is to highlight the fact that it can influence the health of residents. Therefore, the association between PBD and health should be reported and demonstrated, especially in Osaka, although epidemiologists and others in public health often feel that identifying social determinants of health is pointless if the ability to change social structures lies outside the public health domain.[36] Place-based policies making such as the *Special Nishinari Project* and the *Reform of governmental organized wards in Osaka* are now in progress. However, Osaka city is currently experiencing a period of austerity with reductions in investment for social programs and infrastructure. These

cuts may further marginalize already stigmatized neighborhoods, which is likely to worsen the health of residents.

Limitations

There are several limitations to this study. First, as it is cross-sectional, causal interpretations of the results cannot be established. Whereas the disadvantaged place might damage an individual's health, those who reported poor SRH might be more likely to move into the disadvantaged area. Second, regarding area-level indicators, there are issues of same-source bias and subjective bias.[38] Averaging subjective responses (into quartiles) may be likely to reduce the magnitude of subjective bias in the data. Using census data, rather than an aggregate of study participants, may circumvent the problem of same-source bias. Third, neighborhood characteristics drawn from other aspects (e.g., income inequality, social capital and so on) may be more associated with health than ALPBD, but these relationships will be examined in future research.

Conclusion

Institutionalized PBD may represent an aspect of place which has a greater effect on health than other area-level SES indicators such as ALDI, after adjustment for individual-level factors, in Osaka, Japan. The role of ALPBD in explaining spatial gradients in health may be smaller than that of individualized PBD. However, even if all interpersonal discrimination is eliminated, the institutionalized structures that shape people's opportunities in life from early childhood may be so powerful that we should continue to investigate the association between ALPBD and health.

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Conflicts of Interest and Source of Funding

The authors have no conflict of interest. This study was supported by Grant-in-Aids from the Japanese Ministry of Health, Labour and Welfare (201001042A) and the Japanese Ministry of Education, Culture, Sports, Science and Technology (24300323).

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Table 1. Basic characteristics of subjects (n=2963)

Characteristics		Subjects	Individual-level place-based discrimination, yes		Poor self-rated health	
		N (%)	N (%)	*p* for difference[a]	N (%)	*p* for difference[a]
Sex	Male	1332 (45.0)	61 (4.6)	0.0002	209 (15.7)	0.0032
	Female	1631 (55.0)	130 (8.0)		195 (12.0)	
Age group	25-34 years	660 (22.3)	36 (5.5)	0.0566	57 (8.6)	<0.0001
	35-44 years	820 (27.7)	50 (6.1)		94 (11.5)	
	45-54 years	680 (22.9)	59 (8.7)		107 (15.7)	
	55-65 years	803 (27.1)	46 (5.7)		146 (18.2)	
Perceived place-based discrimination	No	2772 (93.6)	NA		359 (13.0)	<0.0001
	Yes	191 (6.5)	NA		45 (23.6)	
Working status	Working	2294 (77.4)	141 (6.2)	0.474	249 (10.9)	<0.0001
	Not working	502 (17.0)	35 (7.0)		116 (23.1)	
	Unemployed	156 (5.3)	13 (8.3)		37 (23.7)	
	Missing	11 (0.4)	NA		NA	
Housing tenure	Home owner	1705 (57.5)	108 (6.3)	0.7385	181 (10.6)	<0.0001
	Not home owner	1250 (42.2)	83 (6.6)		221 (17.7)	
	Missing	8 (0.3)	NA		NA	
Education attainment	High school or less	1311 (44.3)	102 (7.8)	0.0091	232 (17.7)	<0.0001
	College or more	1646 (55.6)	89 (5.4)		171 (10.4)	
	Missing	6 (0.2)	NA		NA	
Number of friends	0	284 (9.6)	8 (2.8)	0.0189	72 (25.4)	<0.0001
	1-4	1171 (39.5)	72 (6.2)		175 (14.9)	
	5 or more	1480 (50.0)	107 (7.2)		153 (10.3)	
	Missing	28 (0.9)	NA		NA	
Marital status	Married	1750 (59.0)	97 (5.5)	0.0162	199 (11.4)	<0.0001
	Not married	1213 (41.0)	94 (7.8)		205 (16.9)	
Poor self-rated health	No	2559 (86.4)	146 (5.7)	<0.0001	NA	
	Yes	404 (13.6)	45 (11.1)		NA	

[a]Calculated by chi-squared tests
Abbreviation: NA; Not applicable

Table 2. Mean (SD), median, range and correlation matrix of the area-level indicators among 100 tracts, before making quartiles

Area-level indicators		Mean (SD)	Median	Min	Max	Pearson correlation coefficients					
						i	*ii*	*iii*	*iv*	*v*	*vi*
i)	Area-level place-based discrimination, aggregated (ALPBD), %	6.9 (9.4)	3.5	0.0	50.0	1	0.17	0.55	0.23	0.21	0.63
ii)	Area-level unemployment, aggregated (ALUEA), %	5.3 (4.6)	4.4	0.0	18.5		1	0.34	-0.03	-0.02	0.30
iii)	Area-level unemployment, census (ALUEC), %	11.4 (4.0)	11.1	3.0	28.6			1	0.27	0.36	0.90
iv)	Area-level not-home-owner, aggregated (ALNHA), %	44.1 (20.6)	40.0	8.6	100.0				1	0.80	0.43
v)	Area-level not-home-owner, census (ALNHC), %	57.2 (18.4)	55.6	18.5	97.0					1	0.51
vi)	Area-level deprivation index, census (ALDI), score	34.9 (18.7)	31.9	0.0	100.0						1

Abbreviations: SD; standard deviation, Min; minimum, Max; maximum

Table 3. Perceived place-based discrimination and poor self-rated health according to the quartile of the area-level indicators

		Subjects	Individual-level place-based discrimination, yes		Poor self-rated health	
Area-level indicators	Quartile (range)	N (%)	N (%)	*p* for difference[a]	N (%)	*p* for difference[a]
Area-level place-based discrimination, aggregated (ALPBD)	Lowest (0.0-0.0)	869 (29.3)	0 (0.0)	<0.0001	91 (10.5)	0.0009
	2nd (2.7-3.3)	632 (21.3)	19 (3.0)		82 (13.0)	
	3rd (3.4-7.4)	694 (23.4)	34 (4.9)		98 (14.1)	
	Highest (7.7-50.0)	768 (25.9)	138 (18.0)		133 (17.3)	
Area-level unemployed, aggregated (ALUEA)	Lowest (0.0-2.3)	728 (24.6)	49 (6.7)	0.0111	111 (15.3)	0.0149
	2nd (2.6-3.8)	744 (25.1)	30 (4.0)		97 (13.0)	
	3rd (4.0-8.0)	716 (24.2)	49 (6.8)		75 (10.5)	
	Highest (8.1-18.5)	775 (26.2)	63 (8.1)		121 (15.6)	
Area-level unemployed, census (ALUEC)	Lowest (3.0-8.4)	729 (24.6)	23 (3.2)	<0.0001	96 (13.2)	0.0066
	2nd (8.6-10.3)	765 (25.8)	30 (3.9)		88 (11.5)	
	3rd (10.8-13.1)	723 (24.4)	50 (6.9)		91 (12.6)	
	Highest (13.1-28.6)	746 (25.2)	88 (11.8)		129 (17.3)	
Area-level not-home-owner, aggregated (ALNHA)	Lowest (8.6-26.9)	737 (24.9)	32 (4.3)	0.0077	76 (10.3)	0.0077
	2nd (27.3-37.5)	707 (23.9)	46 (6.5)		92 (13.0)	
	3rd (39.3-57.1)	774 (26.1)	48 (6.2)		118 (15.3)	
	Highest (57.9-100.0)	745 (25.1)	65 (8.7)		118 (15.8)	
Area-level not-home-owner, census (ALNHC)	Lowest (18.5-43.2)	738 (24.9)	30 (4.1)	0.0052	88 (11.9)	0.1692
	2nd (43.6-54.4)	734 (24.8)	43 (5.9)		92 (12.5)	
	3rd (54.4-68.5)	755 (25.5)	61 (8.1)		113 (15.0)	
	Highest (68.9-97.0)	736 (24.8)	57 (7.7)		111 (15.1)	
Area-level deprivation index, census (ALDI)	Lowest (0.0-19.9)	751 (25.4)	25 (3.3)	<0.0001	84 (11.2)	<0.0001
	2nd (20.5-31.0)	736 (24.8)	18 (2.5)		98 (13.3)	
	3rd (31.0-46.0)	731 (24.7)	43 (5.9)		81 (11.1)	
	Highest (46.7-100.0)	745 (25.1)	105 (14.1)		141 (18.9)	

Note: Higher quartiles indicate more disadvantaged area [a]Calculated by chi-squared tests