



## **Supporting Information**

### **Supplementary methods and results**

**This appendix was part of the submitted manuscript and has been peer reviewed.  
It is posted as supplied by the authors.**

Appendix to: Lindsay D, Whiteman DC, Olsen CM, Gordon LG. Health care service use by people diagnosed with invasive melanoma in Queensland: a benefit incidence analysis. *Med J Aust* 2023; doi: 10.5694/mja2.52122.

**Table 1.** Codes used for identifying health care services

Variable	Information used
Total hospital admissions	All hospital admissions to public or private hospitals within three years of primary melanoma diagnosis.
Specific melanoma hospital admission	Any hospital admission with the ICD-10 code of C43.0, C43.1X, C43.2X, C43.3X, C43.4, C43.5X, C43.6X, C43.7X, C43.8, C43.9.
Total MBS services	Any claim for a MBS service within three years of primary melanoma diagnosis.
GP services	MBS items 1-4, 13-14, 19-20, 23-26, 33, 35-40, 43-44, 47-51, 193, 195, 197, 199, 585, 594-597, 599, 601-603, 2492, 2497-2501, 2503, 2504, 2506, 2507, 2509, 2517, 2518, 2521, 2522, 2525, 2526, 2546, 2547, 2552, 2553, 2558, 2559, 2574, 2575, 2577, 2578, 5000, 5003, 5007, 5010, 5020, 5023, 5026, 5028, 5040, 5043, 5046, 5049, 5060, 5063, 5064, 5067, 10660, 90001, 90005-90051, 90250-90253, 90264, 90271-90274, 90279, 90280, 91721-91790, 91795, 91800-91802, 91809-91811, 91890, 91891, 91894, 92146-92149, 92154-92157, 92170, 92176, 92182-92184, 92194-92196, 92210, 92216, 92715, 92718, 92721, 92724, 92731, 92734, 92737, 92740, 92746, 93624, 93625, 93634, 93635, 93644, 93645, 93653, 93654, 93680, 93683, 93690, 93693, 93700, 93703, 93715-93716
Specialist services	MBS items 85, 88, 94, 99-100, 102-152, 154-159, 288-289, 291-293, 296-297, 299-338, 342-353, 355-359, 361, 364, 366-367, 369-370, 384-389, 410-417, 501-503, 507, 511, 515, 519-520, 530, 532, 534, 536, 801, 803, 805, 807-809, 811, 813, 815, 820, 822-823, 825-826, 828, 830, 832, 834-835, 837-838, 851-852, 855, 857-858, 861, 864, 866, 871-872, 880, 887-890, 893, 2799, 2801, 2806, 2814, 2820, 2824, 2832, 2840, 2946-2949, 2954, 2958, 2972-2978, 2984-3003, 3005, 3010, 3014-3015, 3018, 3023, 3028-3032, 3040, 3044, 3051-3055, 3062, 3069, 3074-3078, 3083, 3088, 3093, 5001, 5004, 5011-5014, 5016-5017, 5019, 5039, 5041, 5906-5912, 6004, 6007-6009, 6011-6016, 6018-6019, 6023-6026, 6028-6029, 6031-6032, 6034-6035, 6037-6038, 6042, 6051-6052, 6057-6060, 6062-6065, 6067-6068, 6071-6075, 6080-6082, 6084, 10801-10816, 17603-17690, 90260-90263, 90266-90269, 90300, 91822-91841, 91846-91849, 92140-92145, 92162-92167, 92172-92173, 92178-92179, 92422-92713.
Biopsy services	MBS items 30071, 30072.
Excisions for melanoma	MBS items 31300, 31305, 31310, 31315, 31320, 31325, 31330, 31335, 31371, 31372, 31373, 31374, 31375, 31376.
Skin flap/graft services	MBS items 45200, 45203, 45206, 45207, 45000, 45003, 45400, 45403, 45239, 45442, 45445, 45448, 45451, 45665.
Pathology services	MBS items 72813, 72816, 72817, 72823, 72824, 72825, 72826, 72830, 72836, 72818, 72827, 72828, 72838.
PBS services	Any claim for a PBS service within three years of primary melanoma diagnosis.

ICD-10 = International Classification of Diseases, tenth revision. MBS = Medicare Benefits Schedule. GP = general practitioner. PBS = Pharmaceutical Benefits Scheme.

## The concentration index

The concentration index is a summary of a concentration curve (Figure 1), which is a graphical representation of the cumulative fraction of a sample ranked by a variable of interest (e.g., income or socio-economic status) on the x-axis.<sup>1</sup> The y-axis presents the cumulative fraction of a health-based outcome (e.g. health care use) that corresponds to the cumulative fraction of the distribution of the socio-economic variable of interest. The concentration index value is defined as twice the area between the concentration curve (blue and green lines in Figure 1) and the line of equality (solid 45° red line from the bottom left corner to the top right).<sup>1</sup>

When there is no inequality in the health outcome across the socio-economic variable of interest, the concentration index equals zero and the concentration curve will sit along the line of equality. The concentration index will typically be negative if the concentration curve sits above the line of equality, and suggests a disproportionate concentration of the health outcome among more disadvantaged people (blue line). The concentration index will typically be positive when the concentration curve sits below the line of equality, suggesting a disproportionate concentration of the health outcome among less disadvantaged people (green line).

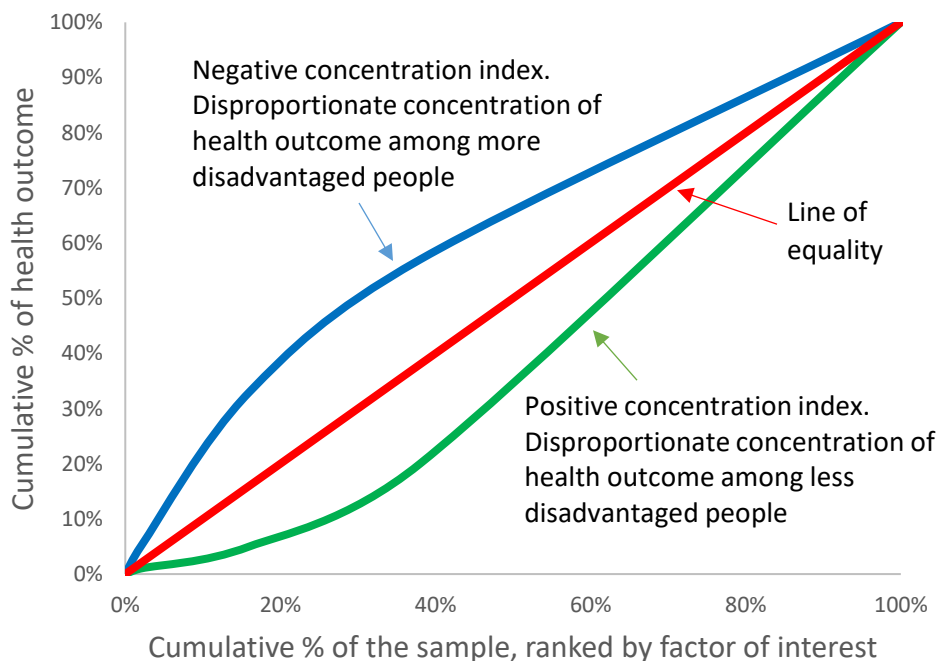


Figure 1. Example of a concentration curve.

### **Choice of concentration index formula**

Since its introduction, several iterations of the concentration index formula have been described, with adjustments made according to the measurement properties of the health-based outcome.<sup>2</sup> As highlighted by Contoyannis et al. (2022), the concentration index formula is valid for a situation only to the extent that measurement properties of the chosen index match the measurement of the health outcome.<sup>2</sup> Full discussion of the different concentration index formulas has been covered in greater detail elsewhere.<sup>2</sup>

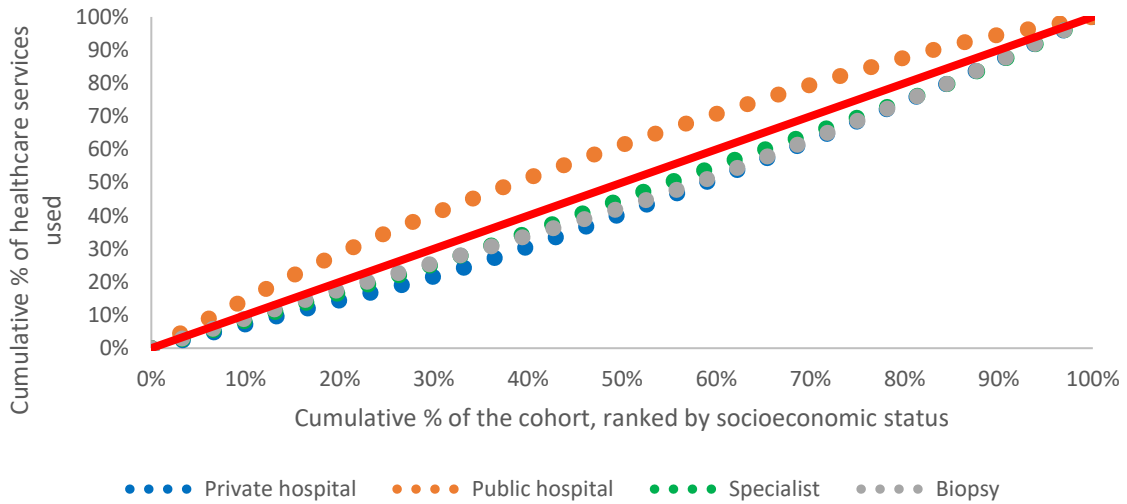
The standard concentration index formula is appropriate for measuring inequality when the health outcome is measured on a ratio scale with a meaningful zero point corresponding to a situation of complete absence.<sup>1,2</sup> The health outcome in our article, health care use, is measured on a ratio scale with a meaningful value of zero, indicating no health care services used. Additionally, no negative values for our health care use measure are possible, and differences between values are measurable in that someone who has used ten health care services has used twice as many services as someone using five. We therefore applied the standard concentration index formula, as our health-based outcome satisfies the criteria for its use.<sup>1,2</sup>

Further, as we were interested in relative as opposed to absolute inequality, the standard concentration index is the correct formula to use.<sup>2</sup> Relative inequality measures differences across ordered social groups (i.e., ordering by socio-economic status or remoteness) and reflects the direction of the social gradient in disease.<sup>3</sup> The value of the relative concentration index is bounded by  $-1$  and  $+1$  if the health variable of interest is restricted to positive values, as is the case in our study.

### References

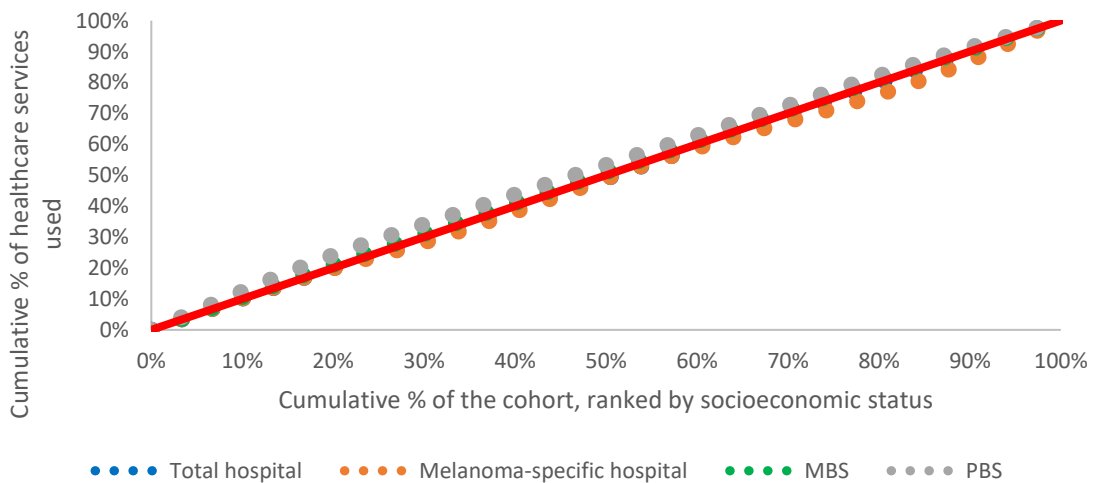
1. O'Donnell O, O'Neill S, Van Ourti T, Walsh B. Conindex: estimation of concentration indices. *Stata J* 2016; 16: 112-138.
2. Contoyannis P, Hurley J, Walli-Attaei M. When the technical is also normative: a critical assessment of measuring health inequalities using the concentration index-based indices. *Population Health Metrics* 2022; 20: 21.
3. Wagstaff A, Paci P, van Doorslaer E. On the measurement of inequalities in health. *Soc Sci Med* 1991; 33: 545-557.

**Figure 2.** Concentration curve for private hospital admissions, public hospital admissions, specialist attendances and biopsies, by socio-economic status



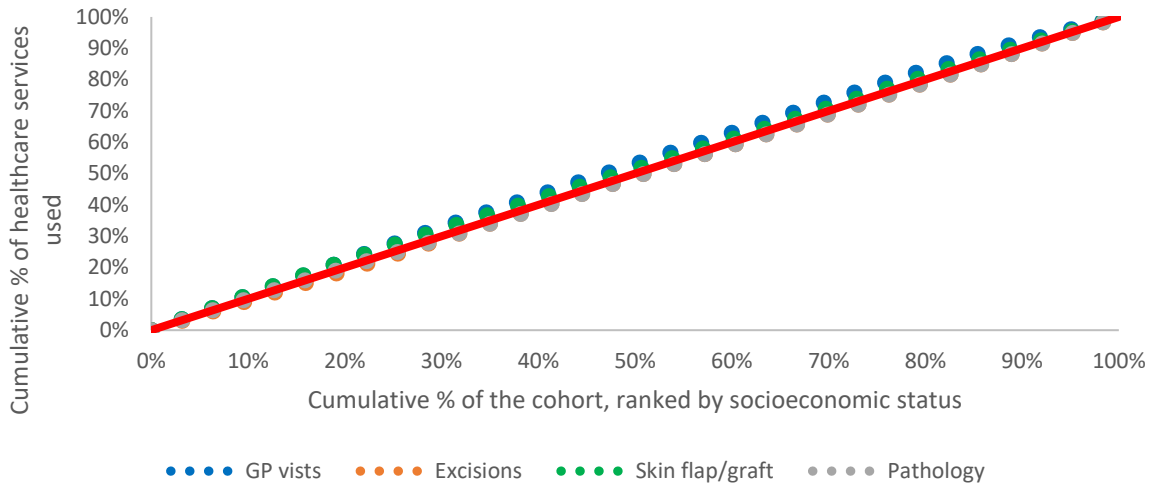
Lines above the above the line of equality (solid red line) indicate disproportionate concentration of health service use for those with greater socio-economic disadvantage. Lines below the line of equality indicate disproportionate concentration of health service use for those with lesser socio-economic disadvantage.

**Figure 3.** Concentration curves for all hospital admissions, melanoma-specific hospital admissions, all MBS services, and all PBS services, by socio-economic status



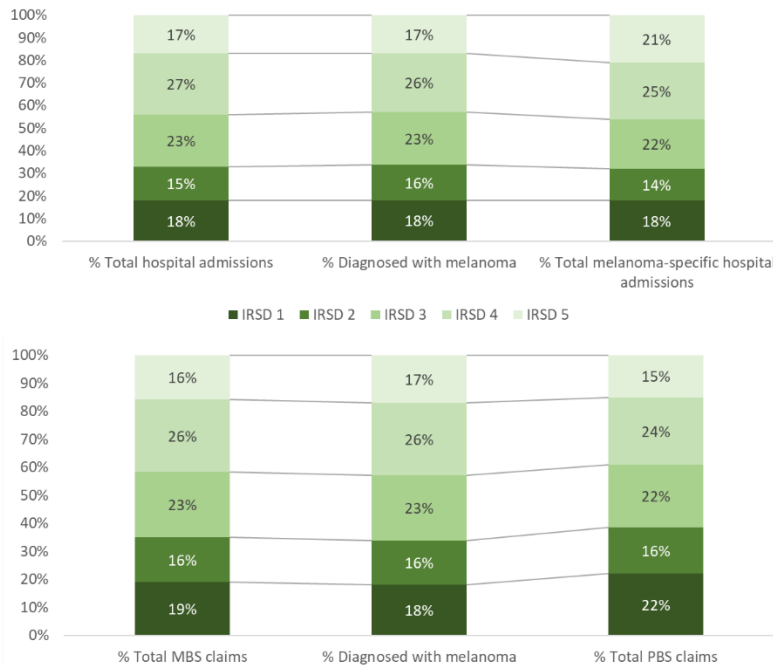
Lines above the above the line of equality (solid red line) indicate disproportionate concentration of health service use for those with greater socioeconomic disadvantage. Lines below the line of equality indicate disproportionate concentration of health service use for those with lesser socioeconomic disadvantage.

**Figure 4.** Concentration curves for GP visits, excisions, skin flap/graft, and pathology procedures, by socio-economic status

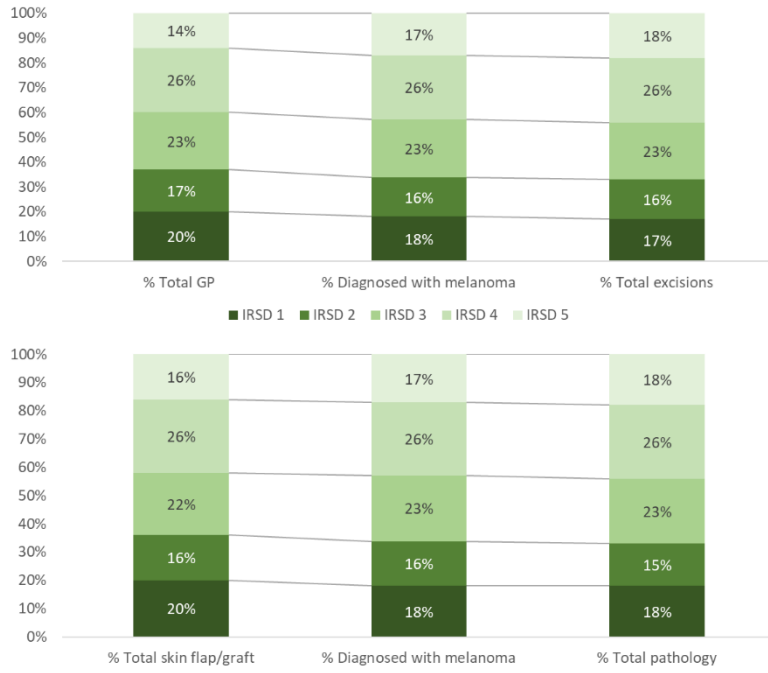


Lines above the above the line of equality (solid red line) indicate disproportionate concentration of health service use for those with greater socioeconomic disadvantage. Lines below the line of equality indicate disproportionate concentration of health service use for those with lesser socioeconomic disadvantage.

**Figure 5.** Distribution of melanoma diagnoses and total hospital and melanoma-specific hospital admissions, and total MBS and PBS services used by socio-economic quintiles



**Figure 6.** Distribution of melanoma diagnoses and GP visits, excision, skin flap/graft and pathology services by socio-economic quintiles



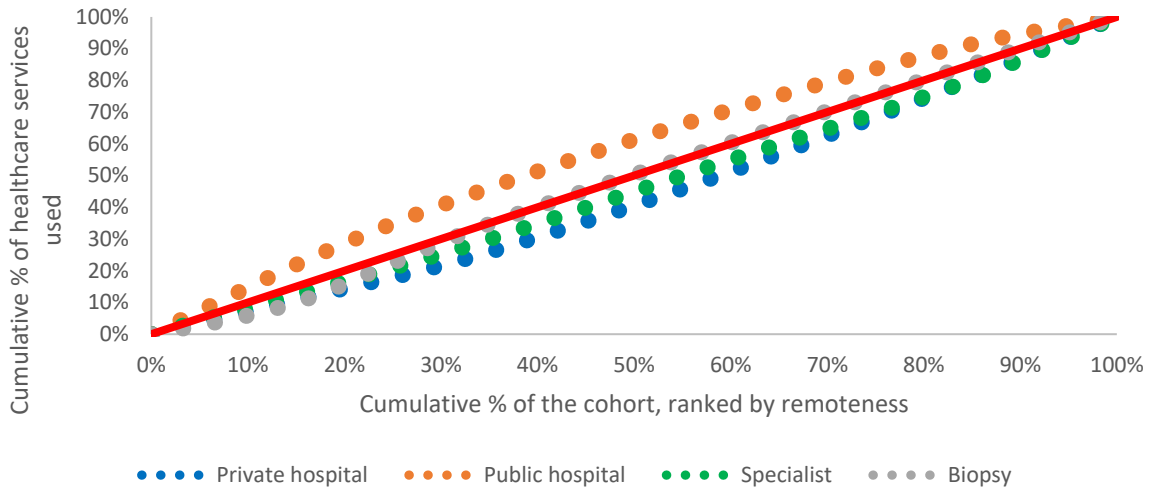
**Table 2.** Concentration indices for health care use by socio-economic status and remoteness and private health insurance status (value, 95% confidence interval)

Service	People using service	Socio-economic status		Remoteness	
		No PHI	Has PHI	No PHI	Has PHI
Total hospital admissions	11,301	-0.04 (-0.08, -0.01)	0.01 (-0.03, 0.04)	-0.02 (-0.06, -0.01)	0.04 (0.01, 0.08)
Public hospital admissions	6,126	-0.09 (-0.14, -0.05)	-0.18 (-0.24, -0.13)	-0.07 (-0.11, -0.03)	-0.14 (-0.18, -0.09)
Private hospital admissions	8,708	0.11 (0.05, 0.16)	-0.04 (-0.01, 0.09)	0.10 (0.05, 0.15)	0.08 (0.04, 0.12)
Melanoma specific hospital admissions	5,947	-0.04 (-0.06, -0.01)	0.03 (0.01, 0.04)	-0.02 (-0.04, 0.01)	0.02 (0.01, 0.03)
Total MBS services	13,259	-0.04 (-0.06, -0.03)	-0.03 (-0.04, -0.02)	0.01 (0.01, 0.03)	0.02 (0.01, 0.03)
GP visits	13,120	-0.05 (-0.06, -0.04)	-0.05 (-0.06, -0.04)	0.01 (-0.01, 0.02)	-0.01 (-0.01, 0.01)
Specialist attendances	11,612	0.02 (-0.01, 0.05)	0.04 (0.02, 0.05)	0.06 (0.04, 0.08)	0.06 (0.04, 0.07)
Biopsies	9,120	0.02 (-0.01, 0.04)	0.03 (0.01, 0.05)	0.02 (-0.01, 0.04)	0.03 (0.01, 0.05)
Excisions	11,080	-0.01 (-0.02, 0.01)	-0.01 (-0.01, 0.01)	0.01 (-0.01, 0.01)	0.01 (-0.01, 0.01)
Skin flap/grafts	4,898	-0.10 (-0.14, -0.06)	-0.04 (-0.06, -0.01)	0.01 (-0.04, 0.04)	0.01 (-0.01, 0.03)
Pathology services	12,911	-0.01 (-0.02, 0.01)	0.01 (0.01, 0.02)	0.02 (0.01, 0.03)	0.02 (0.01, 0.03)
Total PBS services	13,197	-0.07 (-0.08, -0.05)	-0.06 (-0.08, -0.05)	-0.04 (-0.02, 0.01)	-0.02 (-0.03, -0.01)

PHI = private health insurance. MBS = Medicare Benefits Schedule. GP = general practitioner. PBS = Pharmaceutical Benefits Scheme. Bonferroni adjustment set the sig at 0.05/48 = 0.001.

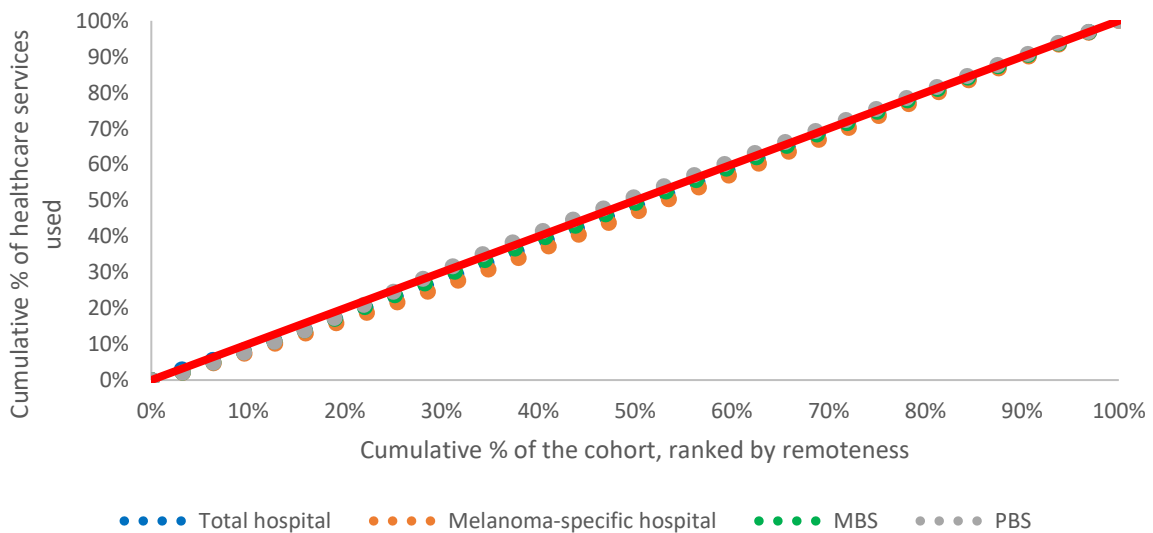


**Figure 7.** Concentration curve for private hospital admissions, public hospital admissions, specialist attendances and biopsies, by remoteness category



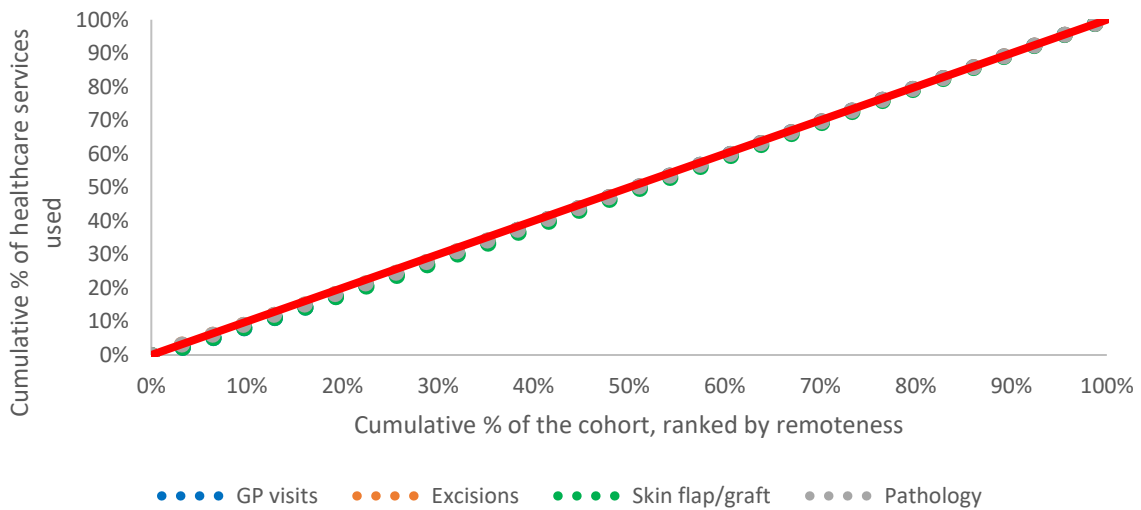
Lines above the above the line of equality (solid red line) indicate disproportionate concentration of health service use for those living in more remote areas. Lines below the line of equality indicate disproportionate concentration of health service use for those living in less remote areas.

**Figure 8.** Concentration curve for total hospital admissions, melanoma-specific hospital admissions, all MBS items and all PBS items, by remoteness



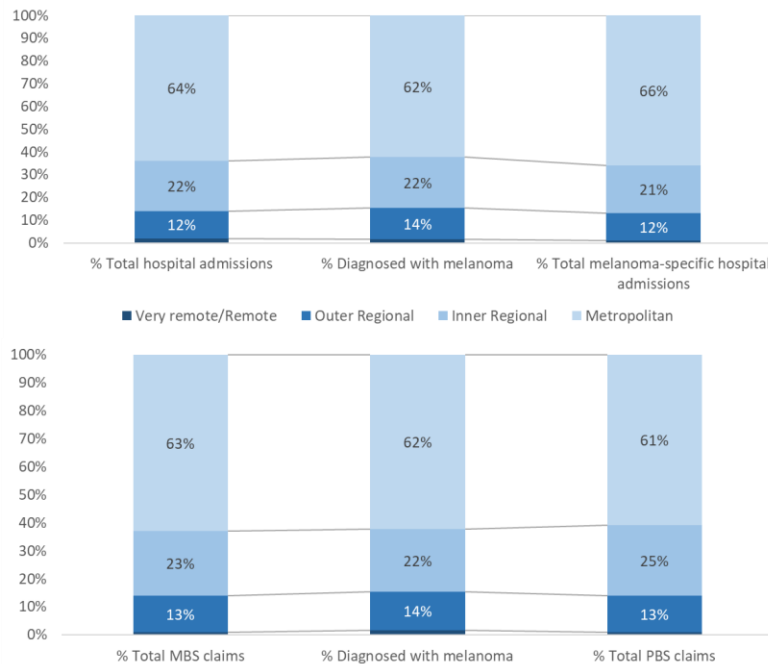
Lines above the above the line of equality (solid red line) indicate disproportionate concentration of health service use for those living in more remote areas. Lines below the line of equality indicate disproportionate concentration of health service use for those living in less remote areas.

**Figure 9.** Concentration curve for GP visits, excisions, skin flap/graft and pathology procedures, by remoteness

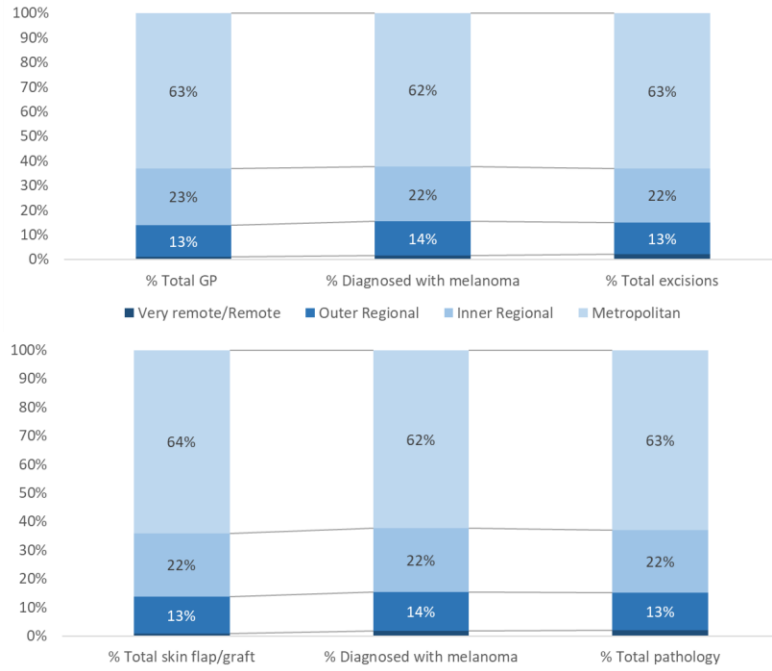


Lines above the above the line of equality (solid red line) indicate disproportionate concentration of health service use for those living in more remote areas. Lines below the line of equality indicate disproportionate concentration of health service use for those living in less remote areas.

**Figure 10.** Distribution of melanoma diagnoses and total hospital and melanoma-specific hospital admissions, total MBS and PBS services used by remoteness groups



**Figure 11.** Distribution of melanoma diagnoses and GP visits, excision, skin flap/graft and pathology services by remoteness groups



**Table 3.** Raw data for Box 3: Diagnoses of invasive melanoma, Queensland, 1 July 2011 – 30 June 2015, and public or private hospital admissions, specialist consultations and biopsies, by socio-economic disadvantage quintile

	Socio-economic disadvantage quintile				
	1	2	3	4	5
Melanoma diagnoses	2373	2071	3072	3385	2244
Public hospital admissions	6938	5238	6164	6063	2676
Private hospital admissions	6263	5876	10986	13913	10245
Biopsies	7689	6504	9782	13864	10960
Specialist consultations	33871	31730	52569	62556	50291

**Table 4.** Raw data for Box 5: Diagnoses of invasive melanoma, Queensland, 1 July 2011 – 30 June 2015, and public or private hospital admissions, specialist consultations and biopsies, by remoteness classification

	Remoteness classification			
	Very remote/ remote	Outer regional	Inner regional	Major cities
Melanoma diagnoses	221	1800	2926	8198
Public hospital admissions	743	4933	6870	14533
Private hospital admissions	382	3964	9392	33545
Biopsies	368	4914	8408	35109
Specialist consultations	2337	23799	45491	159390