General practitioner referrals to exercise physiologists during routine practice: a prospective study

Craike, Melinda, Britt, Helena, Parker, Alexandra and Harrison, Christopher M (2018) General practitioner referrals to exercise physiologists during routine practice: a prospective study. Journal of Science and Medicine in Sport, 22 (4). pp. 478-483. ISSN 1440-2440

Abstract

Objectives: Physical activity is essential in the primary and secondary prevention of several chronic diseases and should be a standard component of clinical care. The aims of this study were to examine the trends and characteristics of referrals to exercise physiologists in routine care in a nationally representative sample of general practitioners (GPs) in Australia.

Design: This prospective study was an analysis of Bettering the Evaluation and Care of Health (BEACH) GP data from April 2009 to March 2016.

Method: In total, each of 6,827 randomly sampled GPs recorded details of 100 consecutive encounters (N= 682,700). The rate of exercise physiologist referrals was calculated by patient and GP characteristics.

Results: Over the study period, the rate at which GPs referred their patients significantly increased from 0.38 to 1.44 per 1,000 encounters. Patients aged 45-64 years were most likely to be referred (1.32 per 1,000 encounters). Patients from non-English-speaking backgrounds were referred at less than half the rate (0.41 per 1,000) of those from English speaking backgrounds (0.96). Female GPs referred patients (1.27 per 1,000 encounters) twice as often as male GPs (0.64). One-third (35.3%) of GP referrals were made for problems relating to the endocrine, nutritional and metabolic systems (e.g., obesity, diabetes mellitus); only 1.6% of referrals were made for mental health conditions.

Conclusions: Although increasing, the rate of GP referral to exercise physiologists was low and associated with patient and GP characteristics. Education of GPs about the role of exercise physiologists in the prevention and management of chronic disease is needed.

Keywords: physical activity, exercise, referral, physician, consultation, exercise practitioner

Introduction

There is conclusive evidence for the benefits of participation in physical activity in both the primary and secondary prevention of a many chronic diseases, including diabetes, cardiovascular disease, some cancers, mental health conditions, and musculoskeletal conditions.[1-4] Peak medical associations, including The Academy of Medical Royal Colleges (UK), Royal College of General Practitioners (UK), and the Australian Medical Association, have acknowledged the important role of physical activity in chronic disease prevention and management[5, 6] .[7] Consequently, there is increasing recognition of the need for physical activity assessment and prescription to become a standard component of chronic disease prevention and treatment

General practitioners (GPs) have a key role in the clinical management of patients with, and at risk of, chronic disease. Given that 85% of Australians visit a GP at least once in any given year, [8] incorporating physical activity advice or referral in general practice has the potential for substantial population reach and impact. GPs could incorporate physical activity in to their practice in several ways, including delivery of advice or referral to exercise practitioners or providers. Delivery of physical activity advice or counselling is challenging for GPs, who have limited consultation times and are not adequately trained to deliver individualised exercise prescription.[9] Thus, it may be efficacious for GP's to refer patients to specialist exercise practitioners, such as exercise physiologists.

Exercise physiologists are university degree qualified practitioners specialising in the delivery of exercise for the prevention and management of chronic diseases and injuries. Internationally, there is increased focus on training and certification of exercise physiologists. For example, the American College of Sports Medicine has a certification program for practitioners with a minimum of a bachelor's degree in Exercise Science, Exercise Physiology or Kinesiology. In Australia, Exercise and Sport Science Australia (ESSA) is the accreditation body for Accredited Exercise Physiologists, who must meet a range of criteria, including a minimum 4 years of study in an accredited course. Exercise physiologists have the expertise and time to deliver individualised exercise programmes that take in to

account the functional and disease-related limitations of the individual and deliver effective behaviour change strategies to facilitate exercise uptake and adherence.[10]

Since the early 1990s there has been increasing implementation of exercise referral schemes, most notably in the UK and New Zealand, These schemes vary in length and scope but generally include a medical practitioner referral to an exercise provider[11, 12]. Currently in Australia, patients can receive rebates (either partial or full) for the services of exercise physiologists through some private health insurance providers or though Medicare, Australia's universal health insurance scheme. Rebates through Medicare require GP development of a Chronic Disease Management Plan, which makes patients eligible to receive up to five sessions per calendar year with a range of Allied Health practitioners, including exercise physiologists.[13] Patient eligibility includes a diagnosis of a chronic health condition, defined as a chronic medical condition that has been, or is likely to be, present for six months or longer, for example, cancer, cardiovascular disease, diabetes, or musculoskeletal conditions.[13]Australia is one of only a few counties in which GPs can refer patients to exercise physiologists to deliver services within a universal, government-funded healthcare system[14].

Internationally and in Australia, there has been limited examination of GP referrals to exercise physiologists in routine care. One Australian study reported the number, age and sex of patients claiming government rebates for exercise physiologist services through chronic disease management plans.[14] However, to the authors' knowledge, there has been no investigation of overall referral rates to exercise physiologists (including referrals that are not part of a chronic disease management plan), the characteristics of GPs who refer patients, nor the characteristics of patients referred. Examination of referral patterns is needed to understand whether the population groups who are likely to benefit most from an exercise referral are receiving such referrals. Population groups who are likely to benefit most from an exercise referral include those more likely to have low levels of participation in physical activity and high rates of chronic disease, such as older adults, people who experience socio-economic disadvantage and people from linguistically diverse backgrounds.[15] Further, examination of the demographic characteristics of GPs who refer patients will assist in the targeting of strategies to increase the overall rate of GP referral to exercise physiologists.

The aim of this study was to examine referrals to exercise physiologists in routine patient care provided by a nationally representative sample of GPs in Australia during the period of 2009 to 2016 inclusive. Specifically, we examined: 1) the overall rate of referral and whether this changed over the study period; 2) the proportion and demographic characteristics of GPs who referred patients to exercise physiologists; 3) the demographic and clinical characteristics of patients who were referred.

Methods

We analysed data from the Bettering the Evaluation and Care of Health (BEACH) study; a continuous national cross-sectional survey of GP activity in Australia operating from 1998 to 2016. We investigated all data recorded by GPs from April 2009 to March 2016, inclusive. The methods have been described in detail elsewhere.[16] However, in summary, each year a new random sample of approximately 1,000 GPs each recorded details of 100 consecutive encounters with consenting patients on structured paper recording forms. Of the GPs who agreed to participate, about 80% completed the project each year. The age–sex distribution of patients at encounters in the BEACH study for whom a Medicare rebatable charge was made for the consultation was repeatedly shown to accurately represent the age-sex distribution of patients at all GP service encounters for which Medicare claims had been made,[16] thus demonstrating the representativeness of the sample.

Details recorded for each encounter included patient characteristics, their reason/s for the encounter, the problems managed, medications (prescribed, supplied or advised for over-the-counter purchase), pathology or imaging tests ordered, any clinical or procedural treatments provided by the GP and any referrals made. These were recorded in free text and secondarily coded using the Australian PLUS terminology, [17] which is classified according to the International Classification of Primary Care (Version 2) (ICPC-2).[18] All management actions were directly linked by the GP to the individual problem being managed. A referral for an exercise physiologist was defined as the ICPC-2 PLUS term “Referral; exercise physiologist” (A66018) which was only introduced to the terminology at the start of the 2009 BEACH recording year. Identifying referrals to exercise physiologists before the creation of this term was not possible.

Our initial analysis examined the GP referral rate to exercise physiologists for each individual year from 2009/10 to 2015/16 inclusive. We included referrals that were made through Chronic Disease Management Plans (and thus rebated through Medicare) as well as those provided at non-Chronic Disease Management claimed encounters. Since we were examining each year's data individually, we were able to weight the data by each GP's activity level (the number of MBS GP items of service claimed) so that each GP's contribution to the sample matched their relative contribution overall. For all other analyses, we examined the 2009-2016 period as a whole and so data were not weighted.

We then examined the patient and GP characteristic-specific referral rate for the combined study years. Patients were grouped by their residential postcode into three geographic areas (Major city, Regional and Remote) according to the Australian Bureau of Statistics Australian Statistical Geography Standard (ASGS)[19] . Patients' residential postcodes were also used to assess their areas relative socio-economic status according to the Australian Bureau of Statistics' Socio-Economic Indexes of Areas (SEIFA) Index of Relative Socio-economic Advantage and Disadvantage. The patient's relative level of advantage and disadvantage was grouped into quintiles. Patients were classified as being from a non-English speaking background (NESB) if the patient reported that they usually spoke a language other than English at home.

The BEACH study used a single-stage cluster design, with a cluster of 100 patient encounters around each GP. Proportions and robust 95% confidence intervals (CIs) were calculated using survey procedures in SAS (version 9.4; SAS Institute Inc, Cary, NC, USA) that adjusted for the study's cluster design. Statistical significance of differences was determined by non-overlapping 95% CIs. Non-overlapping CIs provide a more conservative measure of significance than a 5% alpha, reducing the chance of false positive results while increasing the chance of false negative results.[20]

All GP and patient variables examined at the univariate level were included in a multiple logistic regression. Backwards elimination was used to assess which variables were independently associated with exercise physiologist referral. The multiple logistic regression was performed using the survey logistic procedure in SAS 9.4, which also accounted for the cluster design of the study. We then

looked at the patient and GP characteristic-specific proportion of exercise physiologist referral encounters where a Chronic Disease Management Medicare item was to be claimed for the consultation. Finally, we examined the problems for which exercise physiologist referrals were made.

The BEACH program was approved by the Human Research Ethics Committee of the University of Sydney. The Australian Institute of Health and Welfare Ethics Committee also approved the BEACH study while the two organisations were affiliated (data collected from 2009–2010 for this paper). The funding bodies had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Results

Over the study period, there were 6,827 GP reports on 682,700 patient encounters. There were 619 referrals to exercise physiologists, or 0.91 per 1,000 GP-patient encounters. Over the study period, the rate significantly increased (more than fourfold) from 0.38 per 1,000 encounters in 2009/10 to 1.44 in 2015/16 (Figure 1).

Figure 1 here

Of the 619 exercise physiologist referral encounters, about half (50.9%, 95% CIs: 46.4–55.4) were to be claimed under a Chronic Disease Management Medicare item, compared with only 1.8% (95% CIs: 1.7–1.9) of non-exercise physiologist referral encounters.

There was no difference in the rate at which male and female patients were referred to exercise physiologists (Table 1). Patients aged 45-64 years had the highest (1.32 per 1,000 encounters) and patients aged less than 25 years the lowest (0.24) referral rate. Patients from regional areas had a significantly higher referral rate than those from major cities or remote areas. Patients from NESBs (0.41 per 1,000 encounters) were referred at less than half the rate of patients from English speaking backgrounds (0.96). The only difference in the rate of exercise physiologist referrals by patient level

of advantage/disadvantage was that patients from the second lowest quintile of advantage were significantly more likely to be referred than those in the most advantaged quintile.

Female GPs referred patients to exercise physiologists (1.27 per 1,000 encounters) twice as often as male GPs (0.64) and this applied in both age groups. Younger GPs referred patients to exercise physiologists at a significantly higher rate than older GPs. However, this GP age influence on referral rate was only apparent among male GPs, not among females.

The multivariate analysis showed that after adjustment, all differences identified as significant in the univariate analysis remained except for patient level of disadvantage, which was no longer significant. Further, no new differences emerged after adjustment.

About a third (35.3%) of all referrals to exercise physiologists were made for problems relating to the endocrine, nutritional and metabolic system (see Table 2), predominantly overweight/obesity (16.8%), Type 2 diabetes (10.2%) and lipid disorders (2.7%). Musculoskeletal problems accounted for 31.6% of all problems referred to an exercise physiologist and were most commonly back complaints (6.7%), arthritis (8.5%), osteoporosis (2.7%). Circulatory problems (mainly hypertension 2.9%) accounted for 6.0% of all referrals to exercise physiologists. Psychological problems (largely depression 0.9% and anxiety 0.3%) accounted for only 1.6%, of referrals to exercise physiologists.

Discussion

In this study, we examined GP referrals to exercise physiologists in routine clinical care. To our knowledge, no other study in Australia or internationally has examined referrals to exercise physiologists and reported the characteristics of the patients who were referred and GPs who refer, using a large sample of nationally representative data. Our findings show that the rate of referral to exercise physiologists almost quadrupled from 2009 to 2016 and 50.9% of referrals were made through Chronic Disease Management Plans. The increase in referrals and use of Chronic Disease

Management Plans suggest that the rebates for the Chronic Disease Management items were effective in increasing referrals to exercise physiologists in primary health care settings. The impact of rebates for items such as Chronic Disease Management Plans on GPs referral behaviours has rarely been examined,[21] however there is some evidence that the practices of health care practitioners are influenced by financial incentives in the short term.[22] There are also several other explanations for the increases in referrals to exercise physiologists, including increases in the number of exercise physiologists in Australia [23] and increased awareness of exercise physiologists.

Although increasing, the relative rate of GP referral to exercise physiologists was low, particularly considering that 85% of Australian adults do not meet the combined aerobic and strength physical activity guidelines[24] and more than 11 million (50%) report having a chronic disease[25]. GPs experience a range of barriers to referring their patients to exercise physiologists including lack of time, lack of knowledge about physical activity, lack of confidence and lack of incentives.[26] Although resources about exercise as medicine are freely available through professional associations and networks such as Exercise is Medicine (http://exerciseismedicine.com.au/) ,a study of Australian GPs found that most were unaware of the role of exercise physiologists, and as a result they were reluctant to refer patients to these practitioners.[27] Outreach educational programs and promotion about the role of exercise physiologists, feedback about the outcomes of referrals to exercise physiologists and incentives may assist in overcoming barriers to making exercise referrals.[26, 27] A recent Australian study showed that medical students receive little training about physical activity and thus it is imperative that physical activity is adequately addressed as part of the GP training curriculum.[28] Furthermore, health care practitioners who are more physically active themselves are more likely to prescribe exercise to their patients,[29] suggesting that interventions that target GPs' own health behaviours are likely to increase their referrals to exercise physiologists.

We found that middle-aged patients (aged 45-64 years) were more likely to be referred at GP encounters than either younger (less than 25 years) or older (65 years and over) patients. The rate of referral for older patients was lower than expected, given that 87% of older adults report having at least one chronic disease [25] and engage in lower levels of physical activity than younger and middle

aged adults.[15] Prior research has shown that exercise referrals appear to be particularly effective for older patients, who are more likely than younger patients to take up and adhere to an exercise program when they are referred by their health care practitioner. [11] The lower referrals for older adults observed in our study might be explained by a range of factors, including GPs' lack of knowledge about the benefits of exercise for older adults or concerns about the potential health risks of older adults engaging in physical activity. [30] Alternatively, since older patients visit their GP more often than younger patients, [31] their lower referrals rate per 1000 encounters may merely reflect a lower proportion in the context of an increased number of opportunities for referral. Nevertheless, our findings suggest that GPs might be under-referring older adults to exercise physiologists. Educating GPs about the benefits of exercise for older adults and challenging assumptions about the interest of older adults in being physically active is warranted. Further, educating patient groups about the role of exercise physiologists may lead to increased patient demand for such services.

GPs referred patients from NESBs to exercise physiologists at less than half the rate of patients from an English-speaking background. Adults from linguistically diverse backgrounds are less physically active,[15] and have a higher incidence of chronic disease[32] than other Australians. Encouraging GPs to discuss physical activity with people from NESBs is a challenge, and interventions have not successfully increased promotion of physical activity to these groups.[33] Culturally tailored programs for physical activity promotion may be required for people from NESBs, with investment in co-designed, culturally specific programs and workforce development for health care practitioners.

The most common problems for referral to exercise physiologists were those relating to the endocrine, nutritional and metabolic and the musculoskeletal systems. Strong evidence supports the benefits of physical activity in managing these conditions[3], suggesting that GPs are referring for appropriate health conditions. Only 1.6% of referrals were made for mental health conditions such as depression. This is despite the prevalence of depression, which was the fifth most prevalent condition among patients sampled at a GP visit.[31] A recent systematic review reported that exercise has a large and significant antidepressant effect in people with depression.[2] Thus, referrals to an exercise physiologist

might be underutilised by GPs in the treatment of mental health conditions and educating GPs about the benefits of exercise for mental health conditions is necessary.

We found that the age and gender of GPs predicted referral rates. Female GPs referred patients to exercise physiologists more often than male GPs, regardless of their age; and younger males referred patients more often than older male GPs. Our findings are consistent with previous studies that have shown differences between male and female GPs across a range of patient management and treatment patterns.[34] Previous analysis of BEACH data (the dataset on which the current study is based) showed that female GPs recorded nearly 20% more clinical treatments and referrals than male GPs.[34] Future research that examines the attitudes and experiences of older male GPs regarding exercise referral is warranted and our findings suggest that older male GPs should be the focus of interventions to improve rates of referral to exercise physiologists in primary health care.

The strengths of our study include the prospective research design, focus on routine patient care, and a large, representative sample of GPs.[16] The BEACH study was the only national study of GP activity in the world that was continuous, included all encounters regardless of funding source, and had GP recorded direct linkage of all management decisions and medications to the specific condition under management[8]. Our study's main limitation is the lack of information on the outcome of the exercise referrals, in terms of patient attendance and changes in physical activity or health indicators. However, our study was intended to examine the factors associated with 'access' to referrals to exercise physiologists, rather than their effectiveness in improving health outcomes or participation in physical activity.

Conclusion

The rate at which GPs are referring patients to exercise physiologists is increasing, but still relatively low. Government health care rebates appear to have had a positive influence on the rate of GP referrals to exercise physiologists and should continue. The rate of GP referral to exercise

physiologists is associated with the age and language background of the patient and the age and sex of GPs. Educating GPs about the role of exercise physiologists in the management of chronic disease, including mental health conditions, improving the engagement of GPs themselves in physical activity, and better targeting of patients for referral might lead to increased rates of referral and more advantageous health outcomes.

Practical Implications

- In this large, nationally representative study of GPs in Australia, we found that the rate of referral to exercise physiologists in routine care is low, relative to population levels of physical inactivity and rates of chronic disease.
- We recommend the following actions to increase GP referral rates and better integrate exercise physiologists in the clinical management of patients:
    - Educating GPs, particularly older male GPs, about the role of exercise physiologists in the prevention and management of chronic disease.
    - Advocating for exercise medicine to be embedded into general practitioner training curriculum
    - Educating GPs about the benefits of physical activity for specific population groups, including older adults, people with mental health conditions and people from non-English speaking backgrounds.
    - Advocating for the expansion and continuation of government incentives for GPs to refer patients to exercise physiologists.

References

1. Hordern MD, Dunstan DW, Prins JB, Baker MK, Singh MAF, Coombes JS. Exercise prescription for patients with type 2 diabetes and pre-diabetes: A position statement from Exercise and Sport Science Australia. *J Sci Med Sport.* 2012; 15(1):25-31.

2. Schuch FB, Vancampfort D, Richards J, Rosenbaum S, Ward PB, Stubbs B. Exercise as a treatment for depression: A meta-analysis adjusting for publication bias. *J Psychiatr Res.* 2016; 77:42-51.

3. Kujala UM. Evidence on the effects of exercise therapy in the treatment of chronic disease. *Br J Sports Med.* 2009; 43(8):550-555.

4. Cormie P, Atkinson M, Bucci L, et al. Clinical Oncology Society of Australia position statement on exercise in cancer care. *Med J Aust* 2018; 209(4):184-187.

5. Academy of Medical Royal Colleges. Exercise: The miracle cure and the role of the doctor in promoting it London, UK: Academy of Medical Royal Colleges; 2015.

6. Brooks J, Ahmad I, Easton G. Promoting physical activity: the general practice agenda. *Br J Gen Pract.* 2016; 66(650):454-455.

7. Australian Medical Association. Position Statement: Physical Activity - 2014. https://ama.com.au/position-statement/physical-activity-2014.

8. Britt H, Miller GC, Henderson J, et al. General Practice Activity in Australia 2014–15. Sydney: Sydney University Press; 2015.

9. Douglas F, Torrance N, van Teijlingen E, Meloni S, Kerr A. Primary care staff's views and experiences related to routinely advising patients about physical activity: a questionnaire survey. BMC Public Health. 2006; 6:138.

10. Gillam I. Success story: how exercise physiologists improve the health of Australians. *Br J Sports Med.* 2015.

11. Pavey T, Taylor A, Hillsdon M, et al. Levels and predictors of exercise referral scheme uptake and adherence: a systematic review. *J Epidemiol Community Health.* 2012; 66(8):737-744.

12. Hamlin MJ, Yule E, Elliot CA, Stoner L, Kathiravel Y. Long-term effectiveness of the New Zealand Green Prescription primary health care exercise initiative. *Public Health.* 2016; 140:102-108.

13. Department of Health. Chronic Disease Management (formerly Enhanced Primary Care or EPC) — GP services. http://www.health.gov.au/internet/main/publishing.nsf/content/mbsprimarycare-chronicdiseasemanagement. Accessed 2017 21 March.

14. Cheema BS, Robergs RA, Askew CD. Exercise physiologists emerge as allied healthcare professionals in the era of non-communicable disease pandemics: a report from Australia, 2006-2012. *Sports Medicine.* 2014; 44(7):869-877.

15. Australian Bureau of Statistics. Australian Health Survey: Physical Activity, 2011-12 Canberra: Australian Bureau of Statistics; 2013.

16. Britt H, Miller GC, Henderson J, et al. General Practice Activity in Australia 2015–16. Sydney: Sydney University Press; 2016.

17. Britt H. A new coding tool for computerised clinical systems in primary care--ICPC plus. *Aust Fam Physician.* 1997; 26 (S2):S79-82.

18. World Organisation of Family Doctors. *ICPC-2: International Classification of Primary Care,* 2nd ed. ed, Oxford1998.

19. Australian Bureau of Statistics. Australian Statistical Geography Standard (ASGS). http://www.abs.gov.au/websitedbs/D3310114.nsf/home/geography.

20. Austin PC, Hux JE. A brief note on overlapping confidence intervals. *J Vasc Surg.* 2002; 36(1):194-195.

21. Estabrooks PA, Glasgow RE. Translating effective clinic-based physical activity interventions into practice. *Am J Prev Med.* 2006; 31 (S4):S45-56.

22. Kecmanovic M, Hall JP. The use of financial incentives in Australian general practice. *Med J Aust.* 2015; 202(9):488-491.

23. Exercise & Sports Science Australia. Exercise & Sports Science Australia Annual Report 2017. Brisbane: Exercise & Sports Science Australia; 2017.

24. Bennie JA, Pedisic Z, van Uffelen JG, et al. The descriptive epidemiology of total physical activity, muscle-strengthening exercises and sedentary behaviour among Australian adults - results from the National Nutrition and Physical Activity Survey. BMC Public Health. 2016; 16(1):73.

25. Australian Institute of Health and Welfare. Australia's Health 2016. Canberra: AIHW; 2016.

26. Graham RC, Dugdill L, Cable NT. Health professionals' perspectives in exercise referral: implications for the referral process. *Ergonomics.* 2005; 48(11-14):1411-1422.

27. Ampt AJ, Amoroso C, Harris MF, McKenzie SH, Rose VK, Taggart JR. Attitudes, norms and controls influencing lifestyle risk factor management in general practice. *BMC Fam Pract.* 2009; 10:59.

28. Strong A, Stoutenberg M, Hobson-Powell A, Hargreaves M, Beeler H, Stamatakis E. An evaluation of physical activity training in Australian medical school curricula. *J Sci Med Sport.* 2017; 20(6):534-538.

29. Hebert ET, Caughy MO, Shuval K. Primary care providers' perceptions of physical activity counselling in a clinical setting: a systematic review. *Br J Sports Med.* 2012; 46(9):625-631.

30. Dauenhauer JA, Podgorski CA, Karuza J. Prescribing exercise for older adults: a needs assessment comparing primary care physicians, nurse practitioners, and physician assistants. *Gerontol Geriatr Educ.* 2006; 26(3):81-99.

31. Harrison C, Henderson J, Miller G, Britt H. The prevalence of diagnosed chronic conditions and multimorbidity in Australia: A method for estimating population prevalence from general practice patient encounter data. *PLOS ONE.* 2017; 12(3):e0172935.

32. Hodge AM, English DR, O'Dea K, Giles GG. Increased Diabetes Incidence in Greek and Italian Migrants to Australia: how much can be explained by known risk factors? *Diabetes Care.* 2004; 27(10):2330-2334.

33. Carroll JK, Flocke SA, Sanders MR, Lowenstein L, Fiscella K, Epstein RM. Effectiveness of a clinician intervention to improve physical activity discussions in underserved adults. *Family Practice.* 2016; 33(5):488-491.

34. Harrison CM, Britt HC, Charles J. Sex of the GP--20 years on. *Med J Aust.* 2011; 195(4):192-196.

379 **Table 1: Patient and GP characteristic - specific exercise physiologist referral rate**

Characteristic	Sample size (n = 682,700)	Characteristic specific exercise physiologist referral rate per 1,000 encounters (95% CIs)	Characteristic specific proportion (%) of exercise physiologist referral encounters for which a CDMP item charged (n = 619 exercise physiologist referrals)	Odds ratio from multivariate logistic regression
Patient Characteristics				
Patient sex	*(missing =6,043)*		*(missing = 7)*	Not significant
Male	273,493	0.85 (0.72–0.98)	47.2% (40.0–54.4)	-
Female	403,164	0.94 (0.82–1.06)	53.0% (47.5–58.5)	-
Patient age group	*(missing =5,643)*		*(missing = 5)*	*p < 0.0001*
0-24 years	134,287	0.24 (0.15–0.32)	59.4% (41.5–77.2)	0.23 (0.15-0.35)
25-44 years	152,226	0.96 (0.78–1.14)	45.9% (37.2–54.5)	0.93 (0.72-1.19)
45-64 years	185,821	1.32 (1.13–1.52)	51.2% (44.6–57.8)	1.39 (1.12-1.74)
65+ years	204,723	0.93 (0.77–1.09)	53.2% (45.9–60.4)	Reference group
Patient residential location	*(missing =14,976)*		*(missing = 9)*	Not significant
Major city	462,921	0.80 (0.70–0.91)	51.6% (45.9–57.3)	-
Regional	194,863	1.20 (0.99–1.40)	50.2% (43.0–57.4)	-
Remote	9,940	0.50 (0.06-0.94)	60.0% (16.9–100.0)	-
Patient language background	*(missing =66,446)*		*(missing = 56)*	p = 0.0004
English speaking	563,027	0.96 (0.85–1.07)	54.5% (32.9–76.2)	Reference group
Non-English speaking	53,227	0.41 (0.23–0.59)	50.3% (45.4–55.1)	0.43 (0.27-0.68)

Patient level of advantage	*(missing = 15,581)*		*(missing = 10)*	Not significant
1st quintile (Lowest)	92,604	0.83 (0.60–1.06)	37.7% (27.6–47.7)	-
2nd quintile	110,849	1.18 (0.93–1.43)	55.7% (46.5–65.0)	-
3rd quintile	140,493	0.92 (0.74–1.10)	48.1% (39.0–57.1)	-
4th quintile	129,330	0.95 (0.74–1.16)	56.9% (47.6–66.2)	-
5th quintile (Highest)	193,843	0.77 (0.63–0.91)	52.3% (43.9–60.8)	-
GP Characteristics				
GP sex	*(missing =0)*		*(missing = 0)*	*p <0.0001*
Male	393,500	0.64 (0.54–0.74)	46.6% (39.7–53.5)	Reference group
Female	289,200	1.27 (1.09–1.45)	53.8% (47.9–59.7)	1.79 (1.42-2.27)
GP age	*(missing =4,100)*		*(missing =1)*	*p <0.0001*
<55 years of age	390,400	1.15 (1.00–1.29)	45.9% (37.8–54.0)	1.84 (1.41-2.40)
55+ years of age	288,200	0.59 (0.47–0.71)	52.7% (47.2–58.1)	Reference group
GP age and sex	*(missing =4,100)*		*(missing = 1)*	*Included above*
Aged <55years and male	185,100	0.93 (0.76–1.10)	52.3% (45.7–61.0)	
Aged <55 years and female	205,300	1.34 (1.12–1.57)	52.9% (45.9–59.9)	
Aged 55+ years and male	206,000	0.38 (0.28–0.49)	34.2% (22.9–45.5)	
Aged 55+ years and female	82,200	1.11 (0.79–1.43)	56.0% (45.5–66.6)	

Note: Missing data removed

CDMP– Chronic Disease Management Plan

Table 2: Body system of problems referred to an exercise physiologist at encounter

Body system of problems for which referral was made	N (n=697)	Proportion of problems referred (95% CIs)
Endocrine, nutritional and metabolic	246	35.3% (31.6–39.0)
Musculoskeletal	220	31.6% (27.7–35.4)
General and unspecified	135	19.4% (16.1–22.7)
Circulatory	42	6.0% (4.3–7.8)
Digestive	12	1.7% (0.6–2.9)
Neurological	12	1.7% (0.8–2.7)
Psychological	11	1.6% (0.4–2.7)
Other	19	2.7% (1.5–4.0)

Note: a referral could relate to more than one problem managed, so there were more problems referred than there were referrals made

Figure caption

Figure 1: Exercise physiologist referrals per 1,000 GP patient encounters by BEACH year