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Networks of trainees: examining the effects of attending an interdisciplinary research training camp on the careers of new obesity scholars

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Abstract: Students training in obesity research, prevention, and management face the challenge of developing expertise in their chosen academic field while at the same time recognizing that obesity is a complex issue that requires a multidisciplinary and multisectoral approach. In appreciation of this challenge, the Canadian Obesity Network (CON) has run an interdisciplinary summer training camp for graduate students, new career researchers, and clinicians for the past 8 years. This paper evaluates the effects of attending this training camp on trainees' early careers. We use social network analysis to examine the professional connections developed among trainee Canadian obesity researchers who attended this camp over its first 5 years of operation (2006–2010). We examine four relationships (knowing, contacting, and meeting each other, and working together) among previous trainees. We assess the presence and diversity of these relationships among trainees across different years and disciplines and find that interdisciplinary contact and working relationships established at the training camp have been maintained over time. In addition, we evaluate the qualitative data on trainees' career trajectories and their assessments of the impact that the camp had on their careers. Many trainees report that camp attendance had a positive impact on their career development, particularly in terms of establishing contacts and professional relationships. Both the quantitative and the qualitative results demonstrate the importance of interdisciplinary training and relationships for career development in the health sciences.

Keywords: social network analysis, training, research collaboration, interdisciplinary

Introduction

The US National Institutes of Health Roadmap for Medical Research identifies the training of health science researchers capable of collaborating across disciplines as a top priority. This emphasis is based on the perception that multidisciplinary, interdisciplinary, or transdisciplinary teams will be more responsive and effective in their work and better able to translate findings into practice. Though these terms are often used interchangeably, Rosenfield distinguishes between multidisciplinary (researchers who work in parallel to address a common problem), interdisciplinary (researchers who work together on a common problem, but still maintain individual disciplinary perspectives), and transdisciplinary research (researchers who work together using a shared conceptual framework).[1]

To understand, prevent, and treat obesity, researchers and clinical practitioners agree that interdisciplinary and transdisciplinary approaches are necessary.[2–4] The determinants and consequences of obesity can be considered from clinical, biological, social, and psychological perspectives.[5–7] Thus, any attempts at prevention and/or

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treatment of obesity should consider the complex etiologic nature of the disease. For instance, the Foresight 2007 report on obesity compels researchers and policy makers to move beyond individually focused interventions to multilevel, societal approaches.[8] This perspective is further endorsed by the World Health Organization in its *Global Strategy on Diet, Physical Activity and Health*.[9] Additionally, professionals who work in the field of obesity management and prevention stress that effective obesity prevention and treatment services must adopt an interprofessional approach.[10–14]

However, traditional academic training continues to take place in disciplinary silos. Though collaborative work is generally understood to enhance scientific enquiry and improve productivity,[15–18] it is acknowledged to be difficult due to differing academic socialization between disciplines and institutional challenges.[19–21] It is especially hard for graduate students and other trainees, who tend to be isolated within their departments in their home institutions, to engage in interdisciplinary or transdisciplinary work.[22] This is particularly the case in obesity research where the more senior scholars and lab directors tend to act as gatekeepers when it comes to opportunities for collaboration and do not encourage younger scholars to get involved in interdisciplinary or transdisciplinary work.[23]

Other barriers for trainees, who have typically invested much time and resources in developing expertise in their discipline, include: exposure to discipline-specific jargon; lack of respect for the methods and methodology of other disciplines; acknowledgment of the substantial time required to develop expertise in more than one discipline; a perception that it may be difficult to publish interdisciplinary or transdisciplinary research; and concerns that training in transdisciplinary fields will limit success in their careers.[24,25]

In recognition of the challenges faced by young professionals training in obesity research in Canada, the Canadian Obesity Network (CON) founded an interdisciplinary training camp in 2006. The goals of this Obesity Boot Camp (OBC) are to bring together young researchers and clinicians from across Canada and to provide them with a sound outline of the scientific and methodological issues around obesity research. The camp covers aspects of obesity ranging from epidemiology and public health to cell biology, energy regulation, clinical management, and health policy.

The OBC held annually, is 7 days of intensive teaching and networking exercises, offered to 24 of the top young obesity researchers in the country and internationally. The camp is advertised through the CON website obesitynetwork.ca and newsletter. To qualify as a participant, trainees are required to submit an application including a curriculum vitae and statement as to why they should be selected. All costs, including travel and accommodation, are covered by the CON. Once at the camp, attendees participate in two lectures per day, along with journal club sessions. The instructors are Canadian-based obesity researchers who are recognized in their respective fields. Discussion and debate are encouraged with much of the interaction occurring in or through teams and collaborative work. Thus, whether it is in the academic sessions or the social events, many opportunities exist for participants to be exposed to different perspectives and traditions and to interact with peers from other disciplines. The question is whether such a training initiative can, or has, fostered interdisciplinary and transdisciplinary relationships among future obesity researchers and health professionals in Canada?

In this paper, we use social network analysis, a research tradition originating in cognitive psychology and anthropology in the 1930s and 1940s and now commonly used in sociology and public health, to examine the patterning of four relationships among former OBC attendees across Canada – knowing, contacting, and meeting each other, and working together. We assess the past and current (in the previous year) connections among the former trainees and evaluate their reports of how attendance at the interdisciplinary training camp affected their career trajectories.

Specifically, the paper is organized around the following research questions:

1. How much contact and collaboration has occurred among OBC attendees from the years 2006–2010, both overall (since OBC attendance) and in the past year?
2. How does year of attendance affect the amount and type of contact and collaboration?
3. How does discipline of study affect the amount and type of contact and collaboration?
4. Is year of camp attendance or discipline more important in determining connections among former trainees, in addition to individual-level attributes, such as sex, institutional affiliation, and provincial residence?
5. What are the career trajectories of former OBC trainees, and how do they feel that attendance at the camp impacted their careers and goals?

Methods

In July 2011, a complete list of training camp attendees for the first 5 years of the camp (2006–2010) was obtained from CON. There were 119 attendees total, all of whom were contacted via email and asked to complete an online survey.

Each attendee was provided an alphabetized list of the other 118 attendees from all previous years. We did not list the year of attendance for each trainee or organize the list of names by year of attendance, as we did not want trainees to simply check off the names of others who attended OBC the same year. For each of the other attendees, first respondents were asked if they "know" the person, to which they could respond: "no;" "know of;" "know casually;" or "know well." Next, they were asked to indicate if they had any of the following relationships with each of the others: "have met;" "have contact with;" and "work with." For these three relationships, respondents were asked to specify whether the relationship had occurred: "over a year ago;" "in the last year;" or "in the last month."

For all of the relationships, respondents were only able to select one response for each person. We did not define "met," "contact," or "work with," so respondents were free to interpret these terms widely. "Contact," for example, could include contact in person, by telephone, or by electronic mail. The survey took ~20 minutes to complete. Respondents were informed that their names would be converted to random identification numbers and that their responses would be anonymized.

Descriptive information collected on the respondents included: sex; degree program; province of residence, institution and department at the time of attending the camp; highest degree obtained; current employment status; province of residence; institution and department in 2011. The data were collected online through to the end of August 2011. A total of 107 attendees (90%) responded to the survey. Response rates varied by year: 83% for 2006 attendees; 96% for 2007 attendees; 75% for 2008 attendees; 96% for 2009 attendees; and 100% for 2010 attendees.

The study was approved by the Conjoint Faculties Research Ethics Board at the University of Calgary (Calgary, AB, Canada). To comply with recommendations from the the Conjoint Faculties Research Ethics Board, all individuals who did not respond to the survey were completely removed from the data. Thus, the complete networks consist only of the individuals who returned their surveys.

Network analyses

We conducted a whole network analysis of all the attendees at the OBC from 2006–2010.[26] Since, we had data on the strength of ties, we created two networks for each relationship. For the relationship "know," the first network includes all ties ("know of," "know casually," and "know well"). The second network only includes the "know well" ties. For each of the other relationships (contact, met, and work with), we created two networks based on when the connections occurred. The first set of networks includes all ties mentioned, regardless of time frame (over 1 year ago, in the past year, in the past month). The second set of networks only includes ties that occurred in the past year (in the past year and in the past month). Thus, the second set of networks refers to connections and relationships that occurred during the 2010–2011 year.

It is important to recognize that for the 2010 attendees, "in the past year" includes the time they spent at the training camp. For all other respondents, though, the camp occurred over a year ago. Thus, we can assume that any connections made "in the last year" among trainees from the 2006, 2007, 2008, and 2009 camps were made outside of the context of the training camp. We must also recognize that, compared to more recent trainees, those who attended the camp in 2006 have had longer to make connections "overall."

To answer our first research question – "How much contact and collaboration has occurred among OBC attendees from the years 2006–2010, both overall (since training camp attendance) and in the past year?" – we examined the whole networks of all 107 previous attendees. For all of these networks, we examined the following whole network measures: out degree (average and standard deviation); and the number of isolates. These network measures are described in the following paragraph.

The out degree measures the number of others a respondent mentions or the number of people in the network with whom they report having this particular relationship. We examined the average degree for each network to illustrate the average amount of interaction in each network. We also examined the standard deviation of the average degree in each network to examine how much variation there is in interaction in each network.

Isolates are individuals who are not connected to any others in a network. The number (or percentage) of isolates in a network indicates the number (or percentage) of respondents who are not involved with any other network members for a particular activity.[27]

To answer our second research question – "How does year of attendance affect the amount and type of contact and collaboration?" – we examined the whole network measures described previously (out degree and isolates) by year of attendance. We then examined, separately for each year and for each network, the percentage of ties that are to attendees from the same year.

To answer our third research question – "How does discipline of study affect the amount and type of contact and collaboration?" – we examined the whole network measures (out degree and isolates) by discipline of study. We then examined, separately for each discipline and each network, the percentage of ties that are to attendees from the same discipline.

To answer our fourth research question – "Is year of camp attendance or discipline more important in determining connections among former trainees, in addition to individual-level attributes such as sex, institutional affiliation and provincial residence?" – we performed a Quadratic Assignment Procedure (QAP) regression to predict connections between trainees.[28–30] This procedure was implemented in UCINET 6 (Analytic Technologies, Lexington, KY, USA).

There were 5,671 dyads created by multiple relations among the 107 researchers. These dyadic observations were not statistically independent, thus the data violated the assumptions of Ordinary Least Squares (OLS) regression. The QAP regression procedure, which overcomes the limitations of autocorrelation, is best understood as a form of simulation.[30] First, OLS coefficients are calculated for the independent variables in the regression. Next, the rows and columns of the dependent variable matrix are randomly permuted, and the OLS regression coefficients are recalculated. The simulation is repeated 2,000 times in UCINET 6. The initial regression coefficients are then compared with the distribution of all possible coefficients, and significance tests are based on these distributions.

Qualitative analyses

To answer our fifth research question – "What are the career trajectories of former camp trainees, and how do they feel that attendance at the camp impacted their careers and goals?" – we first examined data on the trainees' career trajectories by year of camp attendance.

Next, we conducted a qualitative content analysis[31–33] of the written responses to two open-ended questions:

1. What are your current career goals (in 2011)?
2. How did attending the camp impact your career?

Data were analyzed using a line-by-line technique and coded using an inductive approach to content analysis.[33] Initial levels of coding involved assigning basic descriptive codes to all raw data and then identifying raw data themes. Once the raw data themes had been identified and the basic descriptive codes were organized according to these themes, the raw data themes were grouped into lower-order themes, higher-order themes, and general dimensions. We conducted frequency counts at the level of general dimensions. These counts represent the number (displayed as percentages) of respondents who answered in accordance with that particular theme; some respondents provided more than one response per question.

Results

Sample description

As illustrated in Table 1, the sample contains 100 attendees from across Canada and seven who attended the camp from other countries. Over 93% of the trainees were enrolled at Canadian universities, while 6% were enrolled at universities in other countries. Most of the students (66%) were enrolled

Table 1 Sample descriptives

Variable	N	%
Camp year		
2006	20	18.7
2007	23	21.5
2008	18	16.8
2009	22	20.6
2010	24	22.4
Sex		
Male	23	21.5
Female	84	78.5
Province during camp		
Alberta	11	10.3
British Columbia	10	9.3
Manitoba and Saskatchewan	5	4.8
Maritimes*	7	6.5
Ontario	46	43.0
Quebec	21	19.6
Outside Canada	7	6.5
Institution during camp		
Canadian university (23 universities)	100	93.5
University in another country	6	5.6
Other	1	0.9
Degree working on during camp		
MA/MSc	19	17.8
PhD	71	66.4
MD	5	4.6
Postdoc	6	5.6
Missing	6	5.6
Discipline		
Medicine	23	21.5
Basic science	14	13.1
Kinesiology	31	29.0
Nutrition	18	16.8
Social sciences	17	15.9
Other	4	3.7
Total	107	100.0

Note: *Maritimes includes Nova Scotia, New Brunswick, and Prince Edward Island.
Abbreviations: BA, Bachelor of Arts; BSc, Bachelor of Science; MA, Master of Arts; MSc, Master of Science; PhD, Doctorate of Philosophy; MD, Doctor of Medicine; Postdoc, Postdoctoral researcher.

in Doctorate of Philosophy programs (PhD) when they attended the camp. A further 18% were enrolled in a Master of Arts (MA)/Master of Science (MSc) programs, with the rest enrolled in Doctor of Medicine (MD) programs or working as postdoctoral researchers. The majority of trainees (79%) were women. The camp was truly interdisciplinary, as students attended from many different departments and fields of study. We grouped the fields of study into six general disciplinary areas to avoid identifying individuals where there were only one or two people in a specific field of study or department. The disciplinary areas are: medicine (22% of the sample); basic science (13% of the sample); kinesiology (29% of the sample); nutrition (18% of the sample); and social sciences (16% of the sample).

Network analyses, overall

The networks of all 2006–2010 training camp attendees are described in Table 2. Networks are described for four relations: know; met; contact; and work with. For each of the relations, first, the overall network is described, and then the more restricted/more recent network is described ("know well" in the case of the "know" network and "in the last year" in the case of the "met," "contact," and "work with" networks). Average out degree is presented, as well as the number of isolates. The final column shows the percentage of respondents who report ties in each network.

As we would expect, the average number of ties declines as the intensity of the relationship increases. Thus, respondents said that, on average, they knew 18.57 other trainees, they had met 17.48 other trainees, they had been in contact with 12.63 other trainees, and they had worked with 5.16 other trainees. Respondents reported that on average they had 5.61 other trainees whom they "knew well." In terms of the time frame, respondents reported that on average they had met 10.79 other trainees in the past year, had contact with 8.94 trainees, and had worked with 3.77 trainees in the 2010–2011 year.

The final column in Table 2 indicates the percentage of trainees who are involved in each network. Over 70% of trainees report knowing at least one other trainee "well" and meeting and being in contact with at least one other trainee in the past year. Seventy percent of trainees report having worked with another trainee, and 56% report that they have worked with another trainee in the past year.

Table 2 Networks, descriptive statistics

Network	Mean out degree	SD	Number of isolates	% reporting ties
Know				
Know	18.57	11.91	17	84
Know well	5.61	5.62	30	72
Met				
Met (ever)	17.48	10.37	9	92
Met in 2010–2011	10.79	8.79	30	72
Contact				
Contact (ever)	12.63	10.06	21	80
Contact in 2010–2011	8.94	7.97	25	77
Work with				
Work with (ever)	5.16	5.13	32	70
Work with in 2010–2011	3.77	3.76	47	56

Notes: N=107. Networks not symmetrized; examining out degree only.
Abbreviation: SD, standard deviation.

Network analyses, by year

Table 3 examines the same whole network measures contained in Table 2 (out degree, isolates, and percentage of respondents reporting ties) by year of attendance. It also includes, separately for each year and for each network, the percentage of ties that are to trainees from the same year.

For all the relationships, more recent trainees report a higher average number of ties and – in particular – a higher average number of ties in the past year. This is not surprising since we relied on name recall for our data collection, and trainees who attended the camp longer ago may be more likely to have forgotten fellow camp attendees. However, even those who attended the camp in 2006 report that on average they worked with 2.56 other trainees in the past year.

Interestingly, for all of the relationships, the percentage of ties that are to attendees from the same year increases for the most recent cohorts. Thus, while 2009 attendees report that 46% of those that they have worked with overall are from the same year, 2006 attendees report that only 25% of those that they have worked with overall are from the same year. However, because the sample sizes are so small in each year, the only statistically significant differences in terms of the percentage of ties to the same year occur for the "last year" relationships between the 2010 and 2006. Across all relationships in the last year, attendees from 2010 report a higher percentage of same-year ties than do those from 2006. This finding is not surprising, since for the 2010 attendees, the last year actually includes their time at the OBC.

Network analyses, by discipline

Table 4 examines the network measures by discipline. It also includes the percentage of ties that are to attendees from the same discipline.

In terms of the numbers of ties, there are no statistically significant differences by discipline with the exception of

Table 3 Ties by year

Ties	2006 attendees (N=20)	2007 attendees (N=23)	2008 attendees (N=18)	2009 attendees (N=22)	2010 attendees (N=24)
Know, overall					
Average (SD)	14.00 (10.86)	19.05 (12.70)	17.93 (13.57)	19.83 (11.32)	20.95 (11.28)
% same year	56.39 (20.96)	54.04 (24.00)	65.92 (23.81)	68.61 (23.67)	64.43 (28.91)
Isolates	4	3	3	4	3
% with ties	80	87	83	82	88
Met, overall					
Average (SD)	11.39 (9.22)	19.90 (9.76)	15.38 (12.38)	16.95 (10.02)	22.18 (8.25)
% same year	62.00 (28.69)	64.65 (15.96)	63.88 (29.40)	75.93 (24.86)	73.51 (22.80)
Isolates	2	2	2	1	2
% with ties	90	91	89	95	92
Contact, overall					
Average (SD)	7.29 (5.74)	14.55 (9.86)	13.42 (11.24)	11.10 (10.14)	15.50 (10.99)
% same year	49.99 (28.82)	58.55 (18.40)	54.49 (35.86)	74.92 (26.33)	72.57 (25.27)
Isolates	6	3	6	2	4
% with ties	70	87	67	91	83
Work with, overall					
Average (SD)	3.85 (3.59)	5.00 (4.22)	5.23 (5.78)	5.00 (7.17)	6.60 (5.36)
% same year	24.85 (29.07)	28.13 (24.11)	24.87 (33.44)	45.88 (46.16)	40.37 (25.37)
Isolates	7	1	5	10	9
% with ties	65	96	72	55	63
Know well					
Average (SD)	4.58 (4.14)	4.89 (3.48)	4.64 (6.46)	5.93 (5.47)	7.50 (7.44)
% same year	34.76 (34.30)	42.14 (29.31)	43.09 (40.13)	59.54 (33.06)	64.39 (31.99)
Isolates	8	5	4	7	6
% with ties	60	78	78	68	75
Met, 2010–2011					
Average (SD)	6.73 (6.34)	10.55 (8.42)	5.91 (5.17)	5.82 (5.03)	21.22 (6.11)
% same year	41.59 (32.94)	52.07 (31.27)	52.30 (41.32)	58.53 (37.35)	78.71 (19.84)[a]
Isolates	9	3	7	5	6
% with ties	55	87	61	77	75
Contact, 2010–2011					
Average (SD)	4.54 (4.37)	9.84 (6.87)	8.42 (7.24)	5.32 (5.04)	15.00 (10.04)
% same year	44.26 (35.05)	57.98 (17.75)	53.83 (35.54)	68.61 (31.27)	80.61 (19.17)[a]
Isolates	7	4	6	3	5
% with ties	65	83	67	86	79
Work with, 2010–2011					
Average (SD)	2.56 (2.07)	2.84 (1.74)	4.78 (5.24)	3.22 (2.59)	5.50 (5.47)
% same year	13.89 (22.05)	30.93 (27.94)	38.68 (39.47)	36.31 (41.07)	58.83 (34.11)[a]
Isolates	11	4	9	13	10
% with ties	45	83	50	41	58

Notes: Mean with standard deviation shown in parentheses. Statistical tests (alpha =0.01). [a]2010 higher than 2006.
Abbreviation: SD, standard deviation.

two instances. Kinesiologists report knowing more people, on average (23.14), than attendees from any other discipline; kinesiologists report that they met more people in the past year, on average (15.50), than attendees from all other disciplines except social scientists.

Kinesiologists also appear to have the most homophilous networks by discipline; they report that between 43%–57% of all their ties are to other kinesiologists. Basic scientists appear to have the most interdisciplinary networks, as only between 3%–15% of their ties are to other basic scientists. However, it is important to remember that basic scientists only made up 13.1% of the sample of trainees, while kinesiologists made up 29% of the sample. Thus, kinesiologists had more opportunities to form "same discipline" ties, while basic scientists had fewer opportunities to form "same discipline" ties.

Regression results

Table 5 contains the QAP regression results for the four networks and for the multiplex network, which sums all ties across all relationships. We treat the networks as "valued," so that we are predicting not just the presence, but also the

Table 4 Ties by discipline

Ties	Medicine (N=23)	Basic science (N=14)	Kinesiology (N=31)	Nutrition (N=18)	Social science (N=17)
% sample	**21.5**	**13.1**	**29.0**	**16.8**	**15.9**
Know, overall					
Average (SD)	18.42 (9.82)	15.18 (9.61)	23.21 (12.26)	14.93 (9.31)	14.46 (15.86)
% same discipline	23.26 (12.07)	6.55 (6.54)	43.61 (18.06)[a]	22.43 (23.86)	15.00 (19.39)
Isolates	4	3	2	3	4
% with ties	83	79	94	83	76
Met, overall					
Average (SD)	14.5 (8.41)	11.38 (9.22)	23.14 (9.95)[a]	16.40 (8.31)	14.47 (11.01)
% same discipline	29.88 (26.91)	14.89 (27.07)	44.36 (11.24)[a]	19.24 (16.19)	8.67 (7.25)
Isolates	3	1	2	3	0
% with ties	87	93	94	83	100
Contact, overall					
Average (SD)	13.24 (8.61)	8.58 (9.11)	15.43 (11.11)	8.14 (7.78)	11.82 (11.50)
% same discipline	20.67 (10.35)	7.74 (15.74)	43.78 (20.83)[a]	29.03 (34.81)	18.53 (17.50)
Isolates	6	2	3	4	6
% with ties	74	86	90	78	65
Work with, overall					
Average (SD)	4.07 (5.08)	4.56 (6.35)	5.88 (4.95)	5.50 (6.90)	4.00 (2.65)
% same discipline	16.21 (29.06)	5.56 (16.67)	55.76 (25.00)[a]	36.38 (37.46)	3.61 (7.41)
Isolates	8	5	5	6	8
% with ties	65	64	84	67	53
Know well					
Average (SD)	5.41 (6.48)	3.10 (2.51)	7.33 (6.08)	2.75 (2.18)	7.75 (7.03)
% same discipline	28.43 (37.97)	5.00 (15.81)	57.03 (27.44)[c]	47.22 (44.29)	4.97 (7.29)
Isolates	6	4	4	6	9
% with ties	74	71	87	67	47
Met, 2010–2011					
Average (SD)	7.63 (7.09)	8.22 (7.17)	15.50 (8.58)[b]	7.83 (6.86)	10.50 (10.18)
% same discipline	24.49 (33.95)	2.78 (8.33)	49.51 (17.95)[a]	22.56 (36.90)	11.88 (14.78)
Isolates	7	5	7	6	5
% with ties	70	64	77	67	71
Contact, 2010–2011					
Average (SD)	8.18 (6.68)	5.82 (6.52)	12.44 (9.15)	4.69 (5.36)	9.18 (8.39)
% same discipline	25.30 (19.16)	13.64 (32.33)	52.43 (20.60)[a]	33.66 (40.71)	17.11 (18.44)
Isolates	6	3	4	5	6
% with ties	74	79	87	72	65
Work with, 2010–2011					
Average (SD)	2.55 (2.16)	6.80 (8.04)	4.61 (4.03)	2.00 (1.56)	3.63 (2.13)
% same discipline	25.54 (39.76)	0 (0)	56.91 (27.31)[d]	40.00 (44.58)	4.29 (8.08)
Isolates	12	9	8	8	9
% with ties	48	36	74	56	47

Notes: Mean with standard deviation shown in parentheses. Four individuals were in an "other" discipline (3.7% of the sample). Statistical tests (alpha =0.01). [a]kinesiology higher than all other disciplines; [b]kinesiology higher than all other disciplines except social sciences; [c]kinesiology higher than all other disciplines except nutrition; [d]kinesiology higher than basic sciences and social sciences.
Abbreviation: SD, standard deviation.

Table 5 QAP regression results, valued network ties, and multiplex network

	Know	Contact	Met	Work with	Multiplex
Same sex	–0.017 (0.258)	–0.000 (0.517)	–0.017 (0.238)	–0.019 (0.143)	–0.015 (0.295)
Same year camp	0.404** (0.000)	0.311** (0.000)	0.436** (0.000)	0.075** (0.000)	0.392** (0.000)
Same institution camp	0.170** (0.000)	0.157** (0.000)	0.137** (0.000)	0.168** (0.000)	0.184** (0.000)
Same province camp	0.048 (0.024)	0.039 (0.034)	0.029 (0.081)	0.045* (0.010)	0.047 (0.026)
Same discipline	0.054** (0.000)	0.059** (0.000)	0.055** (0.000)	0.040* (0.002)	0.062** (0.000)
Same institution 2011	0.059** (0.000)	0.106** (0.000)	0.073** (0.000)	0.220** (0.000)	0.117** (0.000)
Same province 2011	0.036 (0.063)	0.059 (0.012)	0.055 (0.015)	0.018 (0.173)	0.051 (0.024)
R^2 (adjusted)	0.222	0.172	0.241	0.127	0.245

Notes: N=107. Standardized coefficients with the significance shown in parentheses. Multiplex network sums the values on know, contact, met, and work with. *Significant at 0.01; **significant at 0.001.
Abbreviation: QAP, quadratic assignment procedure.

strength of each tie. (We ran these regression models on the less intense networks ["know of", "met over a year ago", "contact over a year ago", and "work with over a year ago"] and the more intense networks ["know casually or well", "met within the last year", "contact within the last year", and "work with within the last year"] separately, and results were substantively the same as the results for the valued networks. We only present the results for the valued networks).

Burris argues that when interpreting QAP regression results, the focus should be on the comparative magnitude of the coefficients, rather than on the overall model R^2 or the level of statistical significance for each coefficient.[30] We report the standardized coefficients for each independent variable and their significance level. Discussion will focus on the comparative magnitude of those coefficients that are significant.

There are seven independent variables included in these models: being the same sex; attending the same training camp; coming from the same institution during the training camp; living in the same province during the training camp; coming from the same discipline; working/studying at the same institution in the survey year (2011); and living in the same province in the survey year (2011). Controlling for the other independent variables, sex has no impact on ties among former trainees.

Attending the same training camp significantly increases the likelihood of all of the relationships, controlling for the other independent variables. In fact, attending the same training camp is the strongest predictor of the strength of ties in all of the networks except for the "work with" network. In the "know" and "met" network, attending the same camp is a stronger predictor than any other predictor by a magnitude of four, and in the "contact" and the multiplex network, it is a stronger predictor than any other predictor by a magnitude of three.

The next most important independent variable for the "know," "contact," "met," and multiplex networks is attending the same institution during the training camp. Coming from the same discipline is the next most important predictor for the "know" and "met" relationships, while working at the same institution in 2011 is the next most important predictor for "contact" and the multiplex network. Being at the same institution in 2011 is also important for "know" and "met."

The "work with" relationship is affected by the following variables, of importance: being at the same institution in 2011; coming from the same institution during the camp; attending the camp together; living in the same province during the camp; and then coming from the same discipline. It is interesting to note that although attending the same camp is not the strongest predictor of "work with" (as it is for the other three relationships), it is still a stronger predictor than coming from the same discipline.

Career trajectories

We asked the trainees to describe their employment status and location in 2011. It is important to note that for some trainees (those who attended the camp most recently), this represents their status only a short time following the camp; while for others (those who attended the earlier camps), this represents their status up to 5 years after their attendance at the camp.

Trainees' employment status, highest degree obtained, institutional affiliation, and province of residence in 2011 are shown in Table 6.

We see that by 2011, over 50% of former trainees had finished their PhD or MD studies. In 2011, 50% of the former trainees were still students, 12% were in postdoctoral

Table 6 Status of attendees in 2011

Variable	N	%
Province in 2011		
Alberta	11	10.3
British Columbia	8	7.5
Manitoba and Saskatchewan	4	3.7
Maritimes*	3	2.8
Ontario	52	48.6
Quebec	14	13.1
Outside Canada	15	14.0
Institution in 2011		
Canadian university (23 universities)	78	72.9
University in another country	11	10.3
Hospital	5	4.7
Government agency	7	6.5
Other/unemployed	6	5.6
Highest degree, 2011		
BA/BSc	3	2.8
MA/MSc	49	45.8
PhD	43	40.2
MD	12	11.2
Job in 2011		
Student	53	49.5
Postdoc	13	12.1
Assistant professor	16	15.0
MD	2	1.9
Researcher	10	9.3
Other/unemployed	13	12.2
Total	107	100.0

Note: *Maritimes includes Nova Scotia, New Brunswick, and Prince Edward Island.
Abbreviations: BA, Bachelor of Arts; BSc, Bachelor of Science; MA, Master of Arts; MSc, Master of Science; PhD, Doctorate of Philosophy; MD, Doctor of Medicine; Postdoc, Postdoctoral researcher.

researcher positions, and 15% were working as assistant professors. We find 9% working as researchers in nonacademic settings. As we would expect, these percentages vary by year of camp attendance. Only 5% of those who attended the camp in 2006 are still students in 2011, while 75% of those who attended the camp in 2010 are still students in 2011.

In response to the first open-ended question on the survey, "What are your current career goals (in 2011)?", many of the respondents (42.5%) replied with goals related to obtaining or furthering their academic career, such as: "[… obtaining a] tenure-track faculty position in an academic institution" or becoming an "academic professor." Almost 34 percent of respondents stated goals related to research including "become a principal investigator" and "establish a research program." Other responses included goals pertaining to clinical careers (eg, "to develop a clinical paediatric obesity program"), teaching, private sector, and public sector work (eg, "policy change/health promotion/public health").

Respondents were asked whether attending the training camp had impacted their career trajectory, and 70% responded yes. They were then asked the question: "How did attending the camp affect your career?" This question garnered responses that fit broadly into four general dimensions: generally beneficial (3%); learning and knowledge enhancement (34%); relationship development (50%); and professional and career development (68%). Responses such as, "I loved my time at OBC and have highly encouraged those in my program to apply as it was very beneficial" gave an overall impression that the program was helpful to the trainees.

The majority of respondents provided more specific reasons why they felt the program helped them with their career goals. These included effects on research practices and trajectories, as one trainee wrote: "[I] thought of new angles by which to approach some of my work. In particular, I have added consideration of geographic factors/GIS to some of my work."

The training camp provided opportunities for career enhancement and opportunities that extended beyond the camp as exemplified by a former trainee who wrote: "I have been offered employment (postdoc) via connections from boot camp."

Relationship development was key to the camp experience as one person wrote: "[Attending the camp] provided me with networking opportunities." Another wrote: "It allowed me to make very useful contacts with a group of wonderful people." The training camp provided trainees with a sense of research community not found elsewhere, for example, "boot camp made me feel that I am part of the obesity research community, which I never felt before attending boot camp."

Providing learning and knowledge enhancement opportunities, particularly related to the interdisciplinarity of obesity was cited as a benefit of camp participation. For example, a former trainee wrote, "I have a broader understanding of bias, nutrition, and other extrapersonal factors contributing to physical inactivity for obese and overweight children;" another said, "My whole view regarding obesity is different now. It is much deeper." These expanded understandings of obesity and related research/clinical practices compelled some trainees to explore new and different areas of research or alter their clinical practices, as one person wrote, "knowledge acquired influenced the way I am counselling obese people in the community."

Taken together, the findings from the qualitative data suggest that not only did trainees find the camp to be beneficial through learning/knowledge acquisition, career-related development, and relationship building, but also that these particular benefits aligned with their stated career goals (ie, furthering academic, research, and clinical careers).

Discussion

This paper summarizes the experiences of a sample of trainees from the first five OBCs, held from 2006–2010. Our first research question was: How much contact and collaboration has occurred among OBC attendees from the years 2006–2010, both overall (since OBC attendance) and in the past year? We conclude that there is a lot of contact among former trainees. On average, trainees report knowing 18.57 other trainees; they know an average of 5.61 other trainees "well." They report having worked with 5.16 other trainees, on average, and having worked with 3.77 other trainees in the past year. Over 70% of former trainees reported having contact with and having met at least one other former trainee in the past year. Additionally, 70% reported having worked with another trainee overall, and over 50% reported having worked with another former trainee in the past year. Because of the high levels of contact and collaboration in the past year among trainees from the earlier OBCs, we conclude that contact and collaboration among OBC trainees is maintained for as long as 5 years following attendance at the camp. Other studies have shown that students who participate in interdisciplinary health education are more likely to engage in collaborative work, which eventually leads to better patient safety and quality of care.[34]

Our second research question was: How does year of attendance affect the amount and type of contact and collaboration?

While respondents from the most recent training camp (2010) report more ties than those from the 2006 training camp, other years are not statistically different from 2010. Trainees from 2006 still report working with (on average) 2.56 other trainees during the 2010–2011 year. On average, trainees report that over one-half of the other trainees they "know" and "have met" are from the same year OBC, yet they report that approximately 70% of those they work with are from other years. Thus, there is some evidence that collaborative working relationships have been formed among trainees from different years.

Our third research question was: How does discipline of study affect the amount and type of contact and collaboration? Many of the ties among the trainees also cross disciplinary boundaries. With the exception of the kinesiologists, all the trainees report that their networks are more likely to contain attendees from other disciplines than from their home discipline. Basic scientists and social scientists report having the most interdisciplinary ties, perhaps due to the fact that they only made up (respectively) 13% and 16% of the sample. The lack of interdisciplinary connection within the reported networks of kinesiologists could be explained by the inherently interdisciplinary nature of kinesiology itself. Kinesiology, also referred to as physical education and recreation, includes social, clinical, political, behavioral, and basic scientists, among others scholars, such as historians and critical or social theoretical scholars.

We next asked: Is year of camp attendance or discipline more important in determining connections among former trainees, in addition to individual-level attributes, such as sex, institutional affiliation, and provincial residence? Controlling for other institutional and geographic factors which we would expect to affect relationships (such as attending or working at the same institution and coming from the same province), having attended a training camp together has a stronger effect on whether, and how well former trainees know each other, and on whether and how recently they have had contact or met each other than coming from the same discipline. Attending the same training camp also has a stronger impact on whether former trainees work together than working in the same discipline. Since we note that for all of the relationships, camp year is a stronger predictor than discipline, we conclude that the camp appears to have fostered the openness, tolerance, and respect toward different perspectives that are required for transdisciplinarity.[34,35]

Finally, we asked: What are the career trajectories of former trainees, and how do they feel that attendance at the camp impacted their careers and goals? By 2011, over one-half of these former camp trainees had completed either a PhD or an MD, and many had been successful in obtaining academic and research positions both within and outside of Canada. Although many who attended the more recent camps are still students, most former trainees report aspiring to academic or research careers, with a few hoping to go into clinical or public sector work. Trainees reported that attending the camp had helped them through learning and knowledge enhancement, and through professional and career development. Importantly, one-half the respondents also explicitly indicated that relationships developed at the camp were beneficial to their careers. Thus, the program and mentoring opportunities offered at the camp may have fostered successful career development and alleviated some of the perceived barriers to engaging in collaborative training for new scholars.[25] As discussed in Mbuagbaw et al, in today's global environment, launching a successful health research career requires collaborating, networking, and working on multidisciplinary teams at an early stage of one's career.[36]

Our study is not without limitations that should be recognized. Though we had a high response rate (overall response rate 90%), we recognize that those who did not respond may have been less impacted by their experience at the training camp or may have maintained fewer contacts from their time at the camp. Thus, we may be overestimating the positive effect of camp attendance on collaborative relationships.

We do not know that any of these relationships would not have occurred without the training camp. Nonattendees may have had opportunities to meet obesity scholars from other disciplines at other conferences or workshops. Nevertheless, the qualitative data suggest benefits were attributable to participation in the OBC. The camp was explicitly set up for interdisciplinary training; therefore, those who attended the camp may have been more predisposed to interdisciplinary collaboration than those who did not attend. Thus, we do not know the effect of selection bias on our results.

Conclusion

Obesity arises from a complex interaction of determinants ranging from genetic, behavioral, political, social, and environmental factors.[6,7] Because of the complex nature of the disease, many different sectors (eg, academia, health care, private, public) and approaches need to be coordinated in their efforts. Such complexity also requires that researchers and practitioners have the training, knowledge, and willingness to work together. Our analysis of the OBC may shed some light on how to create effective interdisciplinary and interprofessional networks of researchers and practitioners.

Using social network analytic techniques, we have demonstrated that the former OBC attendees have established and maintained some professional relationships across

geographic, institutional, and disciplinary boundaries. Our respondents are beginning to form a national network of engaged emerging obesity scholars and practitioners. Many OBC participants expressed the direct impact the OBC had on establishing relationships that have helped them in their career paths. Looking forward, we plan to expand the OBC to include more international trainees, to encourage linkages among obesity scholars and practitioners from different countries.

Similar to Fairchild et al's evaluation of a multidisciplinary summer studentship in oncology,[22] our evaluation demonstrates that interdisciplinary training may help create positive views of interprofessional practice among new scholars. Our evaluation goes a step further in demonstrating through social network analysis that the interdisciplinary training actually translated into interdisciplinary working relationships for emerging obesity researchers and clinicians. We suggest that other fields may benefit from implementing a similar interdisciplinary training camp for emerging scholars and practitioners, encouraging them to form working relationships outside their home discipline early in their careers.[17]

Though it is not reasonable to expect an immediate stabilization or decline in obesity rates on account of this training initiative,[38,39] we do hope to see examples of multidisciplinary, interdisciplinary, transdisciplinary, and/or interprofessional collaborations arising from it. These transdisciplinary working relationships bode well for the future of obesity research in Canada, as they demonstrate what Hays calls the foundation of scientific readiness of the various disciplines in Canada to engage in interdisciplinary or transdisciplinary research around obesity.[37] As one participant stated, "[The Boot Camp] introduced me to people that I am now collaborating with. I will continue to work with these colleagues for the rest of my career."

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Disclosure

The authors report no conflicts of interest in this work.

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