Understanding Interdisciplinary Health Sciences Collaborations: A Campus-Wide Survey of Obesity Experts

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Abstract

This paper reports a campus-wide survey of obesity experts that allowed us to understand organizational factors and collaboration patterns affiliated with health sciences research. By combining Google and PubMed searches and the snowball sampling method, we identified and then surveyed 113 obesity experts on their collaborators, research interests, and affiliations with academic departments and research centers. The response rate was 61%. We describe the diversity in organizational affiliations, research interests, journals for disseminating results, and collaboration patterns among the respondents. We also analyze the challenges and research opportunities related to identifying experts and forging interdisciplinary health sciences collaborations. We conclude with possible success factors for sustained interdisciplinary collaborations.

Introduction

"I made 15 phone calls and was finally pointed to someone local, from our university!" This is what we learned from a colleague about her frustrating experience in searching for someone in a specialty area. Although a number of systems have been developed to assist in locating specific expertise[1, 2], expertise identification and cross-disciplinary collaborations remain challenging. In modern medicine, the increasing specialization in health sciences research has encapsulated most research scientists in silos, which interferes with knowledge dissemination across disciplines. Many biomedical scientists do not have convenient information channels or social networking venues to establish effective research collaborations. This impacts negatively on their scientific endeavors, because health problems or diseases tend to be multifactorial in origin, involving physiological, genetic, environmental, behavioral, psychological, and various other factors. Successful prevention and treatment of diseases requires an interdisciplinary approach that allows each scientist to contribute to the solution. The Clinical and Translational Science Award (CTSA)[3] and The NIH Roadmap Interdisciplinary Research Initiatives[4] have presented us with unprecedented opportunities to support health sciences research beyond individual disciplinary boundaries. Columbia University is one of the CTSA awardees. Motivated to reengineer our research enterprise by effectively facilitating interdisciplinary health sciences collaboration, in December of 2007, we initiated a campus-wide survey of obesity experts to facilitate more effective interdisciplinary obesity research. This plan was also driven by the fact that "obesity has reached epidemic proportions globally and is a major contributor to the global burden of chronic disease and disability"[5]. Since obesity is multi-factorial in origin, with both genetic and environmental causes leading to a heterogeneous spectrum of biochemical and physiologic abnormalities, our initiative is relevant and significant and has potential to highlight the challenges involved in forging interdisciplinary health research teams. The study reported here was centered on the following three research questions:

1. How can we effectively characterize and identify "obesity experts"?
2. What are existing collaboration patterns among obesity experts?
3. What are the success factors leading to sustained interdisciplinary health research collaborations?

This study was approved by our institutional IRB (Columbia University IRB number IRBAAAD3631).

Research Design

Our study consisted of three components: (1) iterative identification of obesity experts at our institution; (2) direct data collection using a web-based survey of obesity experts complemented by retrieval of the respondents' PubMed records; and (3) social network analysis of collaboration and publication patterns among obesity experts. The methods for each step are described below.

1. Obesity Experts Identification

To support interdisciplinary collaborations in obesity research, our first task was to identify investigators whose research relates to obesity. Our first challenge was to overcome the lack of a centralized database cataloging scientists working in specific areas. In

addition, "obesity research" has unclear definitions because the terminology used by obesity experts varies across disciplines. For example, "energy metabolism" and "regulation of body weight" were keywords used by obesity experts from different research fields. The word "obesity" lacks sufficient specificity to encompass all the specialties in obesity research. Moreover, many research scientists do not tie their expertise to specific diseases, but use particular methodologies to study several problems. Although they may focus on obesity in a specific project, they do not consider themselves "obesity experts". Indeed, "obesity expert" is a vague concept that characterizes an unspecified population.

Given such challenges, we combined three search strategies: (1) a Google search on the Columbia University Medical Center (CUMC) website using keywords "obesity" and "fat" to identify all the obesity experts followed by manual review; (2) a PubMed search using similar obesity research keywords to identify authors; and (3) the snowball sampling method[6] for iteratively generating additional experts based on referrals from initially identified obesity experts. Moreover, to ensure that our study remained focused on sustained collaborations between obesity experts, we used two inclusion criteria: (a) the scientist's research contributes to knowledge of the etiology, prevention, and treatment of obesity; and (b) the scientist currently holds a faculty or permanent research scientist position within Columbia University.

2. Data Collection

1. Direct data collection: we used SurveyMonkey[7] to implement the following survey:

(1) With which departments are you affiliated?
(2) To which obesity research centers affiliated with CUMC do you belong?
(3) With whom do you collaborate on obesity research?
(4) Please briefly summarize your specialty area(s) in obesity research. Use keywords if necessary.
(5) Please feel free to provide your comments about the survey here.

Questions 1-3 are structured multi-choice questions presented in drop-down menus or checkboxes, while questions 4 and 5 allow for free-text entry. Obesity experts (n=113) received a personalized email invitation with a unique link to the web-based survey[8] from our CTSA Principal Investigator. One reminder was sent to non-responders.

2. Indirect data collection: Besides the survey, we used our institution's "people directory" to collect information about the academic rank and contact information for the identified obesity experts and searched PubMed using the following query to collect co-authorship patterns and journals used by them:

Authorname AND (OVERWEIGHT OR BODY FAT OR OVEREATING OR WEIGHT CONTROL OR WEIGHT MAINT OR WEIGHT REDUC* OR OBES*) AND COLUMBIA**

3. Data Analysis

To analyze collaboration patterns, we used a freely-available social network analysis program Pajek[9], which provides graphical interfaces to visualize large networks with clustering features. Then we combined descriptive statistics and data triangulation methods to correlate organizational affiliation patterns with collaboration patterns to infer success factors for sustained collaboration.

Results

1. Obesity Experts and Their Organizations

We identified 73 obesity experts by the Google search and 393 co-authors by the PubMed search. Since many co-authors were external collaborators outside CUMC that could not be found in our people directory, we decided to use the initial 73 obesity experts as our starting point to conduct the snowball sampling. During data collection, we incrementally sent invitations to the new names suggested by our survey respondents. We iteratively expanded the choice lists for Questions 1-3 in our online survey instrument by adding new names suggested by past respondents to allow future respondents to choose from complete lists of obesity experts, academic departments, and research centers. So far 113 obesity experts in total have been identified and invited to the survey; 30 were identified through the snowball sampling method. The response rate was 61% (69). Three emails (4%) were undelivered; we suspect that they were sent to individuals who had left CUMC. One person (0.8%) could not answer the survey for health reasons. The academic ranks of the 69 respondents are listed in Table 1.

Table 1. The Academic Ranks of Respondents

Academic Rank	Respondents	
Professor	15	22%
Associate Professor	19	27.5%
Assistant Professor	17	24.5%
(Assoc) Research Scientist	5	7%
Instructor	4	6%
Others (e.g., nutritionist)	9	13%
Total	69	100%

The 113 obesity experts were distributed across 53 research fields from 17 departments in multiple schools.

Table 2 shows the details of the academic department affiliations. The majority of obesity experts were in the departments of Medicine (25%), Pediatrics (19%), and Psychiatry (12%), all within the College of Physicians and Surgeons, in the Mailman School of Public Health (11%), and in the Institute for Human Nutrition (9%). Moreover, 20 research centers affiliated with our institution were reported to be actively involved in obesity research. Table 3 illustrated the obesity experts' affiliations with these centers. The three obesity research centers with the most affiliated scientists were the New York Obesity Research Center (58%), the Institute of Human Nutrition (40.3%), and the Diabetes and Endocrinology Research Center (30.6%).

Table 2. Survey Respondents' Distributions across 17 Academic Departments

Academic Departments	Respondents	
Department of Medicine	27	(25%)
Department of Pediatrics	21	(19%)
Department of Psychiatry	13	(12%)
School of Public Health	12	(11%)
Institute of Human Nutrition	10	(9%)
Department of Surgery	9	(8%)
Department of Neurology	4	(4%)
College of Dental Medicine	2	(2%)
Genetics and Development	2	(2%)
Teachers College	2	(2%)
Department of Pathology	2	(2%)
Department of Dermatology	1	(1%)
Diabetes Research Center	1	(1%)
Obstetrics and Gynecology	1	(1%)
Radiology	1	(1%)
School of Social Work	1	(1%)
Biomedical Informatics	1	(1%)
Total	110	(100%)

Table 3 Centers' Coverage of Survey Respondents

#	Centers with Obesity Research	Pop.
1	New York Obesity Research Center	58.1%
2	Institute of Human Nutrition	40.3%
3	Diabetes and Endocrinology Research Center (DERC)	30.6%
4	Naomi Berrie Diabetes Center	27.4%
5	Irving Institute for CTSA	21.0%
6	New York Presbyterian Center for Obesity Surgery	12.9%
7	Comprehensive Adolescent Bariatric Surgery Program	11.3%
8	New York Presbyterian Pediatric Obesity Program	9.7%
9	Weight Control Center	9.7%
10	CUMC Neuroendocrine Unit	9.7%
11	New York State Psychiatric Institute	8.1%
12	Center for Human Genetics	8.1%
13	Comprehensive Cancer Center	3.2%
14	Children's Hospital Center for Best Practices in Obesity Prevention	3.2%
15	Columbia Women's Health Center	3.2%
16	Health & Society Scholars Program	3.2%
17	Morton A. Kreitchman Positron Emission Tomography Center (Columbia PET)	1.6%
18	Center for Metabolic and Endocrine Surgery Research (CMESR)	1.6%
19	International Center for Health Outcomes (ICOHO)	1.6%
20	Center for Children's Environmental Health	1.6%

The majority of our respondents have joint academic departmental appointments (Table 4).

Table 4. Joint Appointments of Respondents

Academic Appointments (N)	Respondents
N = 3	5 (7.2%)
N = 2	32 (46.4%)
N = 1	32 (46.4%)
Total	69 (100%)

Ninety-three percent of respondents were affiliated with at least one of the identified centers: 28% were affiliated with one center, 21% were affiliated with 3 centers, 15% were affiliated with 2 centers, and 7% were not affiliated with any center (Table 5).

Table 5. Respondents' Affiliations with Centers

Centers (N)	Respondents	
N= 7	2	(3%)
N= 6	3	(4%)
N= 5	2	(3%)
N= 4	10	(14%)
N= 3	15	(21%)
N= 2	11	(15%)
N= 1	20	(28%)
N= 0	5	(7%)
Total	69	(100%)

2. Dimensions in Obesity Research

All respondents summarized their research interests related to obesity in 1-2 sentences, which presented us with a great diversity in obesity research. We manually reviewed the self-reported interests and identified the following major dimensions of obesity research with example keywords from the survey:

1. **Etiology**: *body composition, metabolic syndrome, fat cell morphology, adipose tissue in-*

flammation, neighborhood determinants of obesity, early life determinants of obesity, genetics, neuroendocrinology, and early antecedents of obesity

2. **Treatment**: *e.g., surgery, regulation of appetite and body weight, and energy expenditure*
3. **Prevention**: *e.g., weight control, environmental factors, innovative curriculum*
4. **Risk Population**: *e.g., newborn or elderly*
5. **Co-occurring Diseases**: *e.g. cancer, diabetes, and hypertension*

3. Collaboration Patterns

We asked each subject to choose their collaborators in obesity research from the list of names provided with question 3 and to suggest new names that were not listed. We calculated the *indegree* (the total number of incoming arcs), *outdegree* (the total number of outgoing arcs), and *betweenness* centrality (the frequency for the node to be on the shortest path of each other pair of nodes) for each node. Among the 69 respondents, the maximal outdegree is 34 (with 34 collaborators). The maximal indegree is 22. This person with the highest indegree was considered as a collaborator by 22 others and had the highest betweenness (0.087). She is one of the leading obesity experts in our institution. Among respondents with at least one collaborator, the average number of collaborators reported was 8.84.

A surprising fact is that there were 319 one-way collaborations (e.g., A says he collaborates with B, but B does not say so) and only 132 bidirectional collaborations among the 113 obesity experts. In spite of the possible confounding factor of the 61% response rate, by which we may get an incomplete collaborator report, the results indicate that the perceptions and awareness of "collaborator" varied among the respondents. One respondent commented "*It is unclear what co-investigators mean. Theoretically if you are a co-investigator of a center, all key personnel investigators are your co-investigators. Is it what you mean?*" This definition of collaborator was inconsistent with our definition as "a co-author or a co-investigator in obesity research." There were direct vs. indirect and past vs. current collaborators, but the respondents might not be aware of such differences, and hence define and/or report collaborators inconsistently. A follow-up interview would help us further investigate such hypotheses.

To better detect collaboration patterns, we visualized our data in Pajek by using nodes to represent obesity experts, and edges to represent collaborations. Node size corresponds to the node's total degree. Below are two collaboration network examples.

Figure 1 below shows a strong component across seven academic departments, where every pair of nodes is connected. This network contains the key paths linking the seven academic departments.

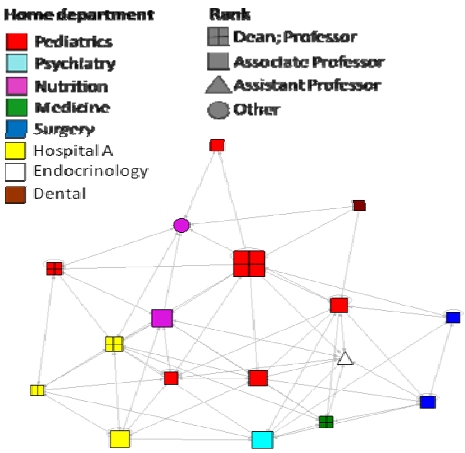

Figure 1. Collaborations across Seven Departments

Figure 2 below shows the only bridge linking the surgery and nutrition experts. It implies that researchers in each community can reach others if they know the two experts that form the bridge.

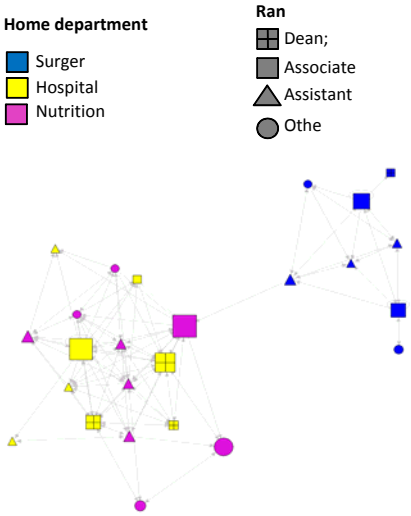

Figure 2. Hospital A and nutrition department collaborate frequently, but there is only one bridge between this cluster and the Surgery department.

4. Publication Sources Analysis

To further measure the interdisciplinarity of our respondents, we searched the PubMed using the query listed earlier and identified 136 journals for 759 obesity-related scientific articles authored by the 69 respondents. Table 6 shows the 20 most popular

journals. Column "Freq" shows the percentage of the 759 papers published in each journal; column "Popu" shows the percentage of respondents with at least one paper in that journal. For example, The American Journal of Clinical Nutrition includes the largest number (120 out of 759; 15.81%) of obesity-related papers. It is used by 14 (20%) of the respondents. We were told that "Obes Res" and "Obesity" were recently merged to become one journal; therefore, it is the most popular journal (used by 37% obesity experts).

Table 6. Usage of the 20 Most Popular Journals

Journal Title	Freq	Popu
Am J Clin Nutr	**15.81%**	20%
Obes Res	7.25%	**20%**
Obesity (Silver Spring)	2.24%	**17%**
Am J Physiol Endocrinol Metab	6.06%	17%
Int J Obes Relat Metab Disord	5.14%	15%
J Clin Endocrinol Metab	3.95%	22%
J Appl Physiol	3.43%	14%
Ann N Y Acad Sci	2.77%	11%
Am J Physiol	2.50%	9%
Int J Obes (Lond)	1.84%	11%
J Clin Invest	1.71%	14%
JPEN J Parenter Enteral Nutr	1.71%	6%
J Nutr	1.58%	6%
Metabolism	1.32%	11%
J Am Diet Assoc	1.32%	9%
Med Sci Sports Exerc	1.32%	9%
Nutr Rev	1.32%	8%
Surg Obes Relat Dis	1.32%	6%
Diabetes	1.19%	11%
JAMA	1.19%	8%
Total=20		

5. Early Uses of The Survey Results

We received great support for this survey. Nineteen respondents (27%) gave comments such as "*Great initiative, I hope this leads to exciting collaborations!*", "*Good idea to stimulate more collaborations*", and "*I applaud this initiative*". Two investigators have used this network resource to forge an interdisciplinary team for childhood obesity prevention or to identify obesity specialists for serving as grant reviewers at Columbia University.

Conclusion

In this study, we identified 113 obesity experts from 17 academic departments, 53 research divisions, and 20 research centers in our university. We gained knowledge of obesity experts' research interests, collaboration networks, and a broad range of journals in use for disseminating research results related to obesity. Such knowledge of the diversity in obesity research and the organizational structure underlying cross-disciplinary collaborations is valuable for our ongoing CTSA effort to forge interdisciplinary health sciences research teams or collaborations. We also identified the following possible success factors for effective interdisciplinary collaboration: (1) establishment of interdisciplinary research centers; (2) identification of boundary spanners who link dispersed research communities; and (3) creation of transdisciplinary scientific journals.

This research demonstrated the effectiveness of combining Google search and the snowball sampling method for expertise identification and highlighted the challenges for accurately profiling and classifying experts, which are crucial for automating expertise recommendation in the future. Our next steps include: (1) to verify the above success factors for sustained collaborations; (2) to reconcile the definitions of "collaborators" provided by different obesity experts; and (3) to develop automated methods for expertise location and recommendation.

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