Family Practice, 2017, Vol. 34, No. 3, 305–312
doi:10.1093/fampra/cmx006
Advance Access publication 21 February 2017

OXFORD

Health Service research

The shifting dynamics of social roles and project ownership over the lifecycle of a community-based participatory research project

Jon Salsberg[a,b,*], Soultana Macridis[b,c], Enrique Garcia Bengoechea[b], Ann C Macaulay[a,b] and Spencer Moore[d], On behalf of the KSDPP School Travel Planning Committee[†]

[a]Department of Family Medicine, McGill University, Montreal, Canada, [b]Kahnawake Schools Diabetes Prevention Project (KSDPP), Kahnawake, Canada, [c]Alberta Centre for Active Living, Faculty of Physical Education & Recreation, University of Alberta, Edmonton, Canada and [d]Arnold School of Public Health, University of South Carolina, Columbia, USA

*Correspondence to Jon Salsberg, Department of Family Medicine, McGill University, 5858 Ch. de la Cote des Neiges, 3rd Floor, Montreal, H3S 1Z1, Canada; E-mail: jon.salsberg@mcgill.ca
[†]See acknowledgements for committee members

Abstract

Background. Community based participatory research (CBPR) is often initiated by academic researchers, yet relies on meaningful community engagement and ownership to have lasting impact. Little is understood about how ownership shifts from academic to community partners.
Objectives. We examined a CBPR project over its life course and asked: what does the evolution of ownership look like from project initiation by an academic (non-community) champion (T1); to maturation—when the intervention is ready to be deployed (T2); to independence—the time when the original champion steps aside (T3); and finally, to its maintenance—when the community has had an opportunity to function independently of the original academic champion (T4)?
Methods. Using sociometric (whole network) social network analysis, knowledge leadership was measured using 'in-degree centrality'. Stakeholder network structure was measured using 'centralisation' and 'core-periphery analysis'. Friedman rank sum test was used to measure change in actor roles over time from T1 to T4.
Results. Project stakeholder roles were observed to shift significantly ($P < 0.005$) from initiation (T1) to project maintenance (T4). Community stakeholders emerged into positions of knowledge leadership, while the roles of academic partners diminished in importance. The overall stakeholder network demonstrated a structural shift towards a core of densely interacting community stakeholders.
Conclusion. This was the first study to use Social network analysis to document a shift in ownership from academic to community partners, indicating community self-determination over the research process. Further analysis of qualitative data will determine which participatory actions or strategies were responsible for this observed change.

Key words: Aboriginal health/native populations, culture and disease/cross-cultural issues, health promotion, prevention, public health, underserved populations.

Introduction

Participatory research is the co-creation of new action-oriented knowledge by researchers working in equitable partnerships with those affected by the issue under study or those who will benefit from or ultimately act on its results (1). Although many PR projects are initiated by academic researchers (2), a central supposition of PR is that sustained action or change is founded on end-users of research products taking 'ownership' of the knowledge creation process (3). These end-users could be, among others, communities, organisations, patients or health care practitioners. Ownership, in this sense, can be seen as the assertion of self-determination by end-user stakeholders who intend to improve their lives, health or practice through active involvement in creating the evidence they need for action, rather than being passive recipients or translators of evidence created by others (4, 5). In order to foster self-determination, PR utilises strategies intended to shift ownership over the research process to the non-academic community stakeholder partners (6). This includes the principal investigator adopting a decision-making structure that shifts the control from academic to non-academic partners over the course of the project.

A partnership can be seen as a network of stakeholders, each representing an individual interest within the project. Therefore, to observe these power dynamics at play within a community-based participatory research (CBPR) partnership, this study took a social network approach to examining the knowledge leadership roles different stakeholders assumed throughout the evolution of a researcher-initiated project. What does the evolution of ownership look like within a CBPR project from the time it is initiated by an academic (non-community) champion (T1); to maturation—the end of program development when it is ready to be deployed (T2); to independence—the time when the original champion stepped aside (T3); and finally to its maintenance—when the network was functioning independently of the original project champion (T4)? Did the network change? If so: (i) Did it exhibit new structural qualities? (ii) Did new central actors emerge? And (iii) Was there significance to the changing roles of actors within the network?

Using an existing CBPR project as a case—the 'Kahnawake Schools Travel Planning (STP) Project', this study mapped the evolution of a researcher-stakeholder committee to determine its structure and paths of knowledge leadership at various points in the project. Paths of knowledge flow are associated with opinion leadership (7, 8) which serves as a useful measure of influence within a network (7). The network was mapped at the four time points described above. Social Network analysis was used to determine changes in the roles of specific actors in the network and their possible influence on other members.

Methods

Context and setting

This study is part of the Kahnawake Schools Diabetes Prevention Project (KSDPP), a 23-year old CBPR partnership between the Kanien'kehá:ka (Mohawk) community of Kahnawake and academic researchers from three Canadian universities. (See online supplementary material for more details about KSDPP, its interventions and evaluation.)

The specific KSDPP intervention serving as our case study is the 'Kahnawake School Travel Planning (STP) Project'. The need to increase opportunities for active and safe routes to school had recently been identified in a school-based physical activity policy development process (9). In 2011, a doctoral student and her academic supervisor approached KSDPP with the idea creating a 'walking school bus' intervention program (10, 11). This idea was welcomed by the community as an opportunity to fulfil the previously identified school physical activity policy need. The STP project development commenced in January 2013 with the formation of a project committee representing the various interested academic and community stakeholders. Intervention planning was completed and the program was first deployed in the community in September 2014.

Social network analysis

This is a cross-sectional design social network study. A social network can be defined as connections among people, organisations or other social actors (7). Although the individual attributes of these actors can help shape their social network, social network analysis (SNA) focuses rather on their relationships to understand how they can influence and constrain the behaviour (7). Studying networks has led to greater understanding of how, among others, diseases, ideas and opinions spread; how people access social support; and who or what influences their health behaviour (12). SNA has examined how health service organisations collaborate to share information, plan and deliver services (13). Within CBPR it has been used to evaluate how community health workers share and use evidence (14), examine interpersonal support networks (15) and issues of access and equity (16). Fuller et al. (17) showed that SNA could serve as an effective and culturally acceptable approach within Indigenous communities: community members considered that the network analysis had accurately described the links between workers related to the exchange of clinical and cultural information, team care relationships, involvement in service management and planning and involvement in policy development (17).

Please see supplementary material on the 'Family Practice' website for a full discussion of the SNA measures used in this study.

This study took a cross-sectional design, mapping the stakeholder network across four time periods to describe the change in individual in-degree centrality and network centralisation over time. Because CBPR aims to activate ownership and self-determination mechanisms over the course of a program, it was hypothesized that the network structure would evolve from one centred around the PI/champion, either to a decentralized one, characterised by diffuse, democratised decision-making, or to a new network structure centralized on a different set of key actors from within the community. Trend analysis explored network dynamics and determined significance of change. This is a sociometric study of the community/academic stakeholder committee for the STP project. Sociometric, or 'whole network' studies, attempt to gather information from everyone within a bounded network, can capture network influences, and are appropriate for instances where the total network membership can be enumerated such as in schools, organisations or small communities (18). This closed-membership committee was a whole network of community stakeholders representing the various interests in the STP project, including school administrators and teachers, parents, public safety and public works officials, along with KSDPP intervention facilitators and academic researchers from McGill University. In total, the network consists of 13 actors, representing the 11 final members of the STP-Committee, plus two other KSDPP individuals who continued in supporting roles but were only directly involved in the committee at the time the idea was initially being discussed.

Data collection

After individual informed consent, each actor in this network was administered a questionnaire covering four occasions in the life of the project. Project initiation (T1) was January 2013 (administered retrospectively in August 2014), maturation (T2) was August 2014, independence (T3) was September 2014 and maintenance (T4) was November 2014.

Network questionnaire

The network questionnaire consisted of a fixed list (roster) of all 13 members of the STP committee with a box next to each name in which respondents could write their rank number. The roster technique was appropriate as we were able to identify the total range of participants within the network beforehand, and can present such a roster to study participants as a means of eliciting their network responses (7). The retrospective item for baseline network relationships (T1), administered in August, 2014, read: 'Looking back to the beginning of the project, please rank the committee members in order of who you would turn to for information relating to the STP project *at that time*'. Participants were instructed to rank only those actors with whom they actually spoke to about the project at that time, and to leave the box blank if they had not spoken with the actor. No recall bias was anticipated due to the close nature of the network participants; respondents reported no difficulties in recalling baseline relationships. For all other sample points (T2, T3 and T4), participants were asked: 'From the provided list of names, please rank the committee members in the order of who you would turn to for information relating to the STP project'. At each time, the respondents were invited to include themselves in their rankings. Follow-up data collections took place in early September (T2), late September (T3) and December (T4) 2014.

Measures

Network mapping and descriptive analysis: Using UCINET 6 SNA software (© 2008 Analytic Technologies; http://www.analytictech.com), 'in-degree centrality' and 'network centralisation' were calculated. Freeman's in-degree centrality (asymmetric model) (19) was calculated for each network member, including diagonal values because ego (oneself) valuing ego as a knowledge source is significant. Response ranks were reverse transposed, so that highest ranking became the highest value for the calculation of tie strength. In-degree centrality is a binary indicator of whether an individual was nominated or not nominated, and does not include the rank-order in its calculation. However, because rank order can stand as a proxy for tie strength (7) we retained the top five nominations from each respondent, representing their five strongest nominations; and thus produced network maps that were demonstrably different for each sample time. Network 'centralisation' was calculated for each sample time. Centralisation is the extent to which the ties within a network are focussed on one or a few actors (7). In a highly centralised network, only one or few actors hold positions of power and control, while decentralised networks are characterized by defused power and control structures. Network centralisation is related to individual centrality in that it is calculated on the difference between the maximum individual centrality score and all the others within the same network.

Description of subgroups and network core-periphery

The description and analysis of groups within a network are important for understanding its structure and how people work together, identify peers and share resources. In other words, groups provide the context in which network members interact (7). The core-periphery structure of a network is the extent to which there exists a group of nodes which are densely connected to each other (the core) and a separate group of nodes only loosely connected to this core or to each other (20). Core-periphery networks may exhibit fairly low centralisation because members of the core have similar centrality scores; yet these networks may still have considerable structure based on the separation between this core group of nodes and others less connected nodes (7, 20). Using UCINET 6 SNA software, core periphery 'fit index' (20), was calculated. The fit index is an indication of how well the network conforms to a core-periphery structure, indicating the extent to which a core exists.

Dynamic network analysis

Network evolution was examined by comparing the cross-sectional network maps generated from in-degree centrality scores at each sample time (T1 to T4). To assess longitudinal network dynamics, we measured the evolution of centrality and network centralisation from T1 to T4. Because a sociometric (whole network) sample violates the statistical assumption of independence, a non-parametric test was employed to examine whether there was change in in-degree centrality measures for individuals across time T1 to T4. The Friedman rank sum test was used as a non-parametric statistical test similar to the parametric repeated measures ANOVA, to detect differences in treatments across multiple test attempts. It is a one-way repeated measures analysis of variance by ranks, and involves ranking each row (time sample) of individuals together, then considering the values of ranks by individuals within each row (21). If actor roles do not change over time, then the ranks of individual actors based on their in-degree centrality measure should remain similar across time, although the total number of connections within the network could change over time. Linear regression analysis for network centralization over time was measured using the Cochran-Armitage linear trend test. This test is used in categorical data analysis to test for the presence of an association between variables across categories (22). Network measures were calculated and graphs generated using UCINET 6.0 and analysed using R 2.12 (© The R Foundation; https://www.r-project.org) statistical software.

Results

Analysis assessed whether actor centrality, paths of information flow, as well as the overall structure of the network, including centralisation and core-periphery, had significantly changed over the course of the four samples.

All 13 STP committee members completed the four questionnaires. Trend test for network centralization over time found that there was no significant linear trend of overall centralization from T1 to T4 (P value = 0.63). However, the network became more centralised from project initiation to maturation (T1 = 33.53% [SD 10.57]; T2 = 58.58% [SD 15.60]); then from maturation through independence and maintenance, the network became steadily less centralised as influence was seen to be shared among a number of community stakeholders (T3 = 34.37% [SD 11.87]; T4 = 29.17% [SD 10.14]).

Table 1 reports individual centrality scores over time. Friedman Rank Sum test was employed to examine whether there was change in in-degree centrality measures for actors across time T1 to T4. Results indicate that there was significant overall change (Friedman chi-squared = 28.56, df = 12, P value < 0.005) in actors'

roles over time. Figures 1 and 2 provide a graphic representation of the changes in actor roles over the four sample periods. Figures 3 and 4 provide a visual matrix of the core-periphery analysis, highlighting the actors present in the core class at each sample time.

At project initiation (T1), the academic PI/champion was the most central figure, with an in-degree centrality score (36.00) considerably above others in the network. As the project's initiator, the PI/champion was, by definition, the knowledge leader and most significant

Table 1. Freeman's in degree centrality measures (19) for individual actors at T1 (initiation-January 2013), T2 (maturation-August 2014), T3 (independence-September 2014) and T4 (maintenance-November 2014)

Committee member	In degree T1	In degree T2	In degree T3	In degree T4
Mike	12.00	11.00	**26.00**	**25.00**
Teresa (acad)	9.00	0.00	0.00	0.00
Joanne	12.00	**25.00**	**35.00**	**25.00**
Andrew	15.00	**20.00**	8.00	13.00
Angela (acad)	11.00	10.00	8.00	5.00
Hank (acad)	26.00	18.00	13.00	10.00
Susan (PI-acad)	**36.00**	**61.00**	**0.00**	**0.00**
David	0.00	10.00	6.00	1.00
Karen	0.00	**19.00**	**32.00**	**26.00**
Alice	3.00	**21.00**	**21.00**	**19.00**
Kevin	4.00	4.00	2.00	0.00
Ron	0.00	0.00	7.00	4.00
Louise	0.00	0.00	0.00	0.00
	In Degree	In Degree	In Degree	In Degree
Std Dev	10.57	15.59	11.87	10.14

Figures in bold highlight evolution of centrality of key actors.
PI-acad = PI/project champion. acad = academic stakeholders. All others are community stakeholders.

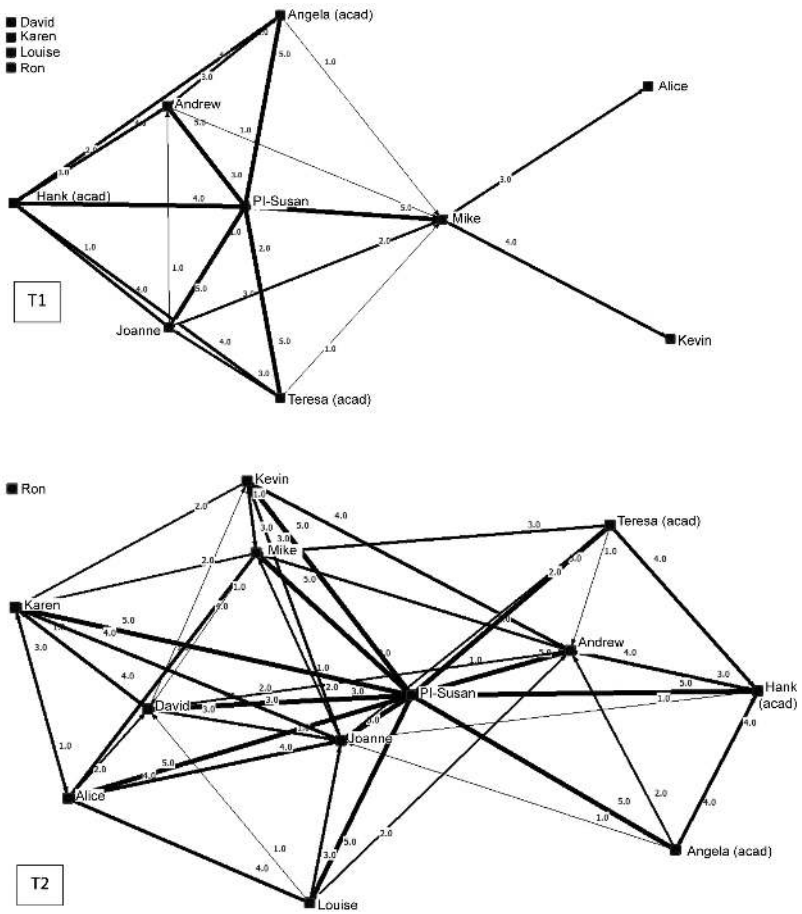

Figure 1. Network at T1 (project initiation-Jan. 2013) and at T2 (project maturation-Aug. 2014) including link weights. (Markers = members; lines = ties; arrow heads = direction of nomination; decimal numbers = number of nominations; markers at top left = isolates [members not nominated]).

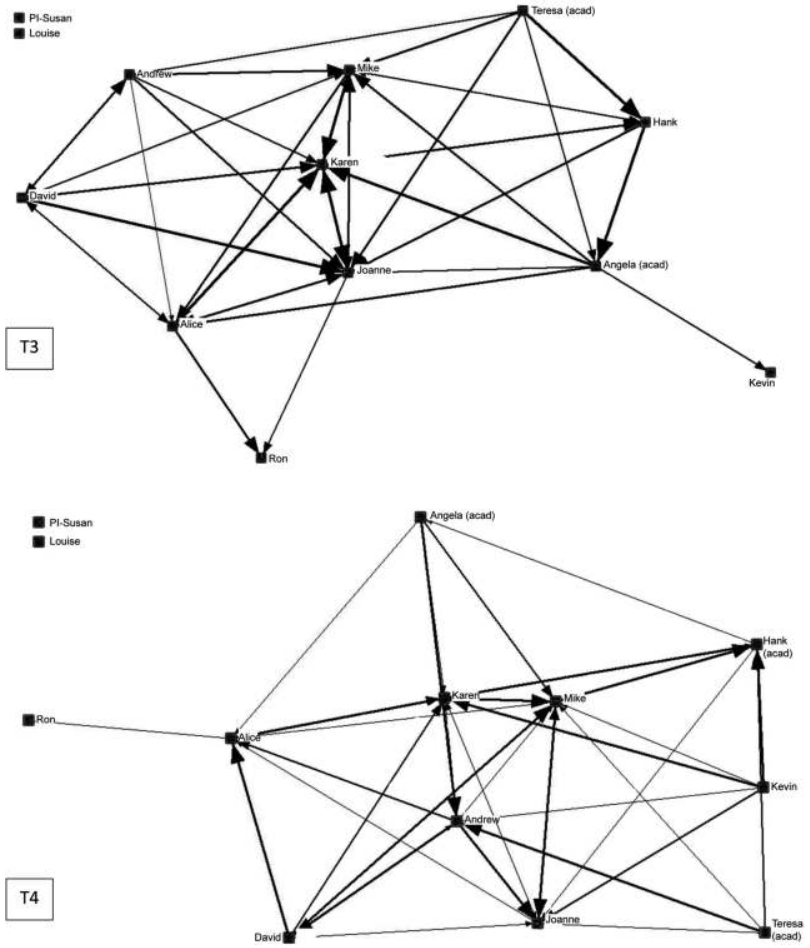

Figure 2. Network at T3 (project independence-Sept. 2014) and at T4 (project maintenance-Nov. 2014) including link weights. (Markers = members; lines = ties; arrow heads = direction of nomination; decimal numbers = number of nominations; markers at top left = isolates [members not nominated]).

T1

		1			1		1 1
		1 8 7 5 1		3 6 4 9 0 2 2 3			
		S J E A M		A D A K L K R T			
1	PI	1 1 1				1	
8	J08	1 1 1 1					
7	E07	1 1		1		1	
5	A05	1 1 1		1			
11	M11	1 1			1 1		
3	A03	1 1 1 1					
6	D06						
4	A04						
9	K09						
10	L10						
2	K02						
12	R12						
13	T13	1 1 1 1					

T2

		1			1	1 1
		1 8 9 5 6 1		4 7 3 0 2 2 3		
		S J K A D M		A E A L K R T		
1	PI	1 1 1 1				
8	J08	1 1 1 1		1		
9	K09	1 1 1		1		
5	A05	1 1 1		1		
6	D06	1 1 1 1			1	
11	M11	1 1 1		1	1	
4	A04	1 1 1 1				
7	E07	1 1 1		1		
3	A03	1 1 1		1		
10	L10	1 1 1 1		1		
2	K02	1 1 1 1 1				
12	R12					
13	T13	1 1 1 1		1		

Figure 3. T1 and T2 Core-Periphery Adjacency Matrix, indicating the core block in the upper left: T1 core-periphery fit index = 0.795. Core-periphery class membership at T1 (Jan. 2013): Core: PI-Susan; Andrew; Hank (acad); Joanne; Mike | Periphery: Kevin; Angela (acad); Alice; Dave; Karen; Louise; Ron; Teresa (acad); T2 core-periphery fit index = 0.626. Core-periphery class membership at T2 (Aug. 2014): Core: PI-Susan; Andrew; Dave; Joane; Karen; Mike | Periphery: Kevin; Angela (acad); Alice; Hank (acad); Louise; Ron; Teresa (acad).

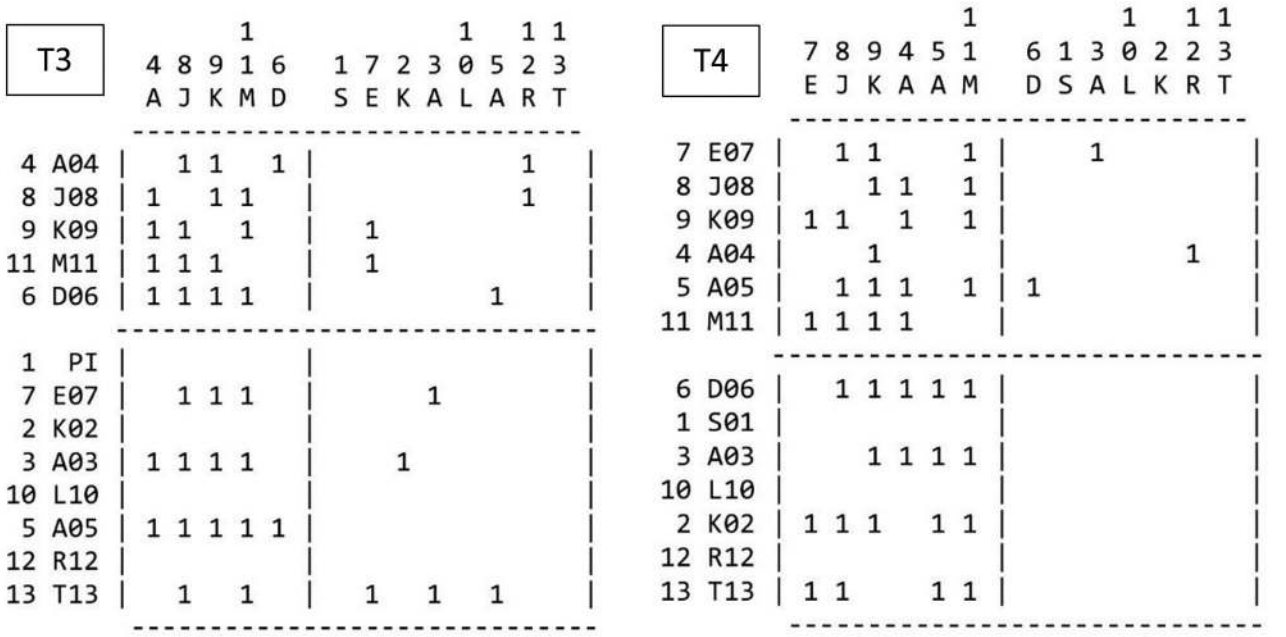

Figure 4. T3 and T4 Core-Periphery Adjacency Matrix, indicating the core block in the upper left: T3 core-periphery fit index = 0.700. Core-periphery class membership at T3 (Sept. 2014): Core: Alice; Dave; Joanne; Karen; Mike | Periphery: PI-Susan; Kevin; Angela (acad); Andrew; Hank (acad); Louise; Ron; Teresa (acad); T4 core-periphery fit index = 0.708. Core-periphery class membership at T4 (Nov. 2014): Core: Alice; Andrew; Hank (acad); Joanne; Karen; Mike | Periphery: PI-Susan; Kevin; Angela (acad); Dave; Louise; Ron; Teresa (acad).

actor in the development of the project at this point. At T1, along with central community actors, other academic actors (Hank [academic supervisor]; Angela; Teresa) were playing a significant role in project development, as indicated by their centrality scores [Note: all names are pseudonyms]. Network centralisation was low at project initiation (33.53%); however, the high core-periphery fit index (0.795) points to significant structure to the network, indicating that knowledge leaders in the core class (PI-Susan; academic supervisor Hank; and community members Andrew, Joanne, Mike) formed a block of dense interaction with the ability to guide the direction of the entire network. At T1, this core class consisted of the PI/champion and her academic supervisor (Hank), as well as three key members of KSDPP, the host organisation (Andrew, Joanne, Mike), but not yet any members of other partnering community organisations.

Once the project committee had worked for 18 months and was ready to deploy the intervention (project maturation—T2), knowledge leadership began to shift toward community stakeholders. At this point, the PI/champion was still involved in the project and playing a key leadership role as seen in her continued dominant centrality score (61.00). Note that the PI's higher centrality score here is due to the fact that a larger network of actors was nominating her at T2 than at T1. However, other academic stakeholders (Angela; Hank; Teresa) were beginning to fade in influence while certain community stakeholders (Andrew; Joanne; Karen; Alice) were emerging to take on knowledge leadership roles, including stakeholders form key partnering community organisations. At T2, the network became more centralised (58.58%), indicating an environment in which the emergent central community actors may have had increased influence over the course of project. The core-periphery fit index at T2 remains moderate (0.626), with a core class (PI-Susan; Andrew; Dave; Joanne; Karen; Mike) consisting of the PI/champion and community stakeholders, but no other academic (non-community) members. The T1 members of this class remained and were joined by two other community members seen as knowledge leaders by their peers at this point.

At T3 the project had reached the point of independence, with the PI/champion stepping aside as planned, once her PhD ended, and leaving deployment and management of the intervention program to the STP committee. At this point new knowledge leaders (Alice; Joanne; Karen; Mike) emerged to assume central roles vacated by the departing PI/champion. Each of these most central figures is a community stakeholder; although the PI/champion's academic supervisor (Hank) remains active in the network with moderate influence (13.00). Overall network centralisation at T3 (34.38%) has returned to a level similar to that at T1; however, core-periphery fit remains high (0.700), with a core class (Alice; Dave; Joanne; Karen; Mike) consisting of key community stakeholders.

Finally, at T4 and the point of project maintenance, the network appeared to be stable with the same community knowledge leaders (Alice; Joanne; Karen; Mike) occupying central positions in a network with about the same degree of centralisation (29.17%) as at T3. At this point the committee had had the opportunity to run the intervention at least once in the absence of the PI/champion and was continuing to meet both individually and as a group to maintain and manage the program. T4 core-periphery fit remained high (0.708) with a core class (Alice; Andrew; Hank; Joanne; Karen; Mike) dominated by community stakeholders. However, it is notable that one academic stakeholder (Hank) and one KSDPP (community) stakeholder (Andrew) remained as part of this core block. The KSDPP stakeholder in question (Andrew), although seen as a community leader, had taken only a supporting role in the development of this project, but his appearance here along with the original PI/champion's academic supervisor (Hank) may indicate a sentiment of needing ongoing support by those most directly involved in managing the intervention—particularly by members Alice and Karen who now are seen to champion the project at the two elementary schools.

Discussion and conclusion

Social network analysis was able to describe the trajectory of ownership over time. At project maturation (T2), the PI/champion remained the most central actor. Yet the centrality scores of all other academic stakeholders had diminished, while those of key community stakeholders from KSDPP as well as key community partner organisations had increased. Measuring overall network centralisation was able to provide insight into the context in which these emergent community actors functioned. The network became more centralised from T1 (33.53%) to T2 (58.58%). Because the role of central actors is more influential within highly centralised networks (7), this may indicate that these emergent community actors have an opportunity to hold stronger knowledge leadership roles in the project. Coupled with the diminished academic centrality scores, this indicates a growth in self-determination through community ownership over the project. By project independence (T3) and maintenance (T4), once the original PI/champion had departed and the project was being sustainably implemented, community leaders are shown to have emerged and maintained their positions over time. This was taking place at T3 and T4 within a network structure that exhibited only moderate centralisation, indicating a more collaborative structure where, once the PI/champion had departed, leadership roles were spread among a group of actors with no clear overall central knowledge leader. Although the PI/champion's academic supervisor remained an active member of the network, his centrality score was significantly below those of the four key community actors, pointing to a maintenance of community ownership and self-determination over the course of the project.

Of the various dimensions of participatory conceptual models (4, 23), the fundamental place of community ownership in creating and sustaining outcomes deserves particular attention. Cargo and Mercer (4) identified community self-determination, the ability of a group to determine their own future, as a principal goal or value that drives PR and lead researchers to take a partnered approach to knowledge creation. Self-determination has been a central topic in community health research since the 1980s as vulnerable populations have attempted to take control over their own health and the evidence, interventions, policies and programs that address it. This has been very evident in research involving Indigenous and minority groups (24) and other marginalised or underserved segments of society (25).

Social network analysis was demonstrated to be an effective tool for describing the evolution of community ownership and self-determination within a participatory project. Results illustrate how these develop as the influence of key actors changes over time. Academic ownership over the project at its initiation (T1) was observed through the central role of the PI/champion at that time. Core-periphery analysis proved useful for providing deeper insight into how academic ownership functioned at this stage. Along with the PI/champion was a core class of stakeholders who were seen to hold knowledge leadership over the direction of the project. However, even within this core class, the PI/champion and her academic supervisor had individual centrality scores significantly above the three other stakeholders from the host/lead community organisation (KSDPP), indicating that despite interest and discussion within the community, academic stakeholders held initial ownership.

Limitations and future research

SNA was able to describe the evolution of a community-based network, but was unable to explain why it evolved. A further qualitative study asking the network participants to describe actions and strategies that led to the observed network change is described elsewhere (see companion paper in this special issue). Due to limitations in time and resources, this study was only able to measure project sustainability (T4 network measures) at a relatively short interval after the departure of the academic PI/champion. However, at the time of manuscript submission—14 months following T4 data, the intervention is still actively being implemented in the two elementary schools under the leadership of the same community stakeholders. We plan follow-up evaluation at a future date will assess the long-term sustainability of both the intervention and its community ownership.

Conclusion

Research 'on' the participatory process often focusses on the concepts, mechanisms and strategies to maintain engagement among community stakeholders in a way that creates sustained ownership over the research and action process (3, 6, 10, 23). Findings from this study demonstrate the evolution of a participatory project from a state of academic ownership to one of sustained community ownership, and set the foundation for further research aimed at understanding PR processes that work to foster this change, particularly in cases where the research idea originates from outside the community.

Supplementary material

Supplementary data are available at *Family Practice* online.

Acknowledgements

We gratefully acknowledge the following members of the KSDPP School Travel Planning Committee who wished to be named: Kanahsohon Deer, Kwawenna:wi Diabo-Alfred, Arlene Goodleaf, Judi Jacobs, Morrison King and Dennis Leborgne.

Declarations

Funding: JS was supported by a Banting and Best Canada Graduate Scholarship from the Canadian Institutes of Health Research (#GSD-121801).
Ethical approval: ethical approval was obtained from the Queen's University General Research Ethics Board, Kingston, Canada. Community ethical approval was obtained from the KSDPP Community Advisory Board, Kahnawake, Canada.
Conflict of interest: none.

References

1. Green LW, George A, Daniel M *et al. Study of Participatory Research in Health Promotion: Review and Recommendations for the Development of Participatory Research in Health Promotion in Canada*. Ottawa: Royal Society of Canada, 1995.
2. Salsberg J, Macaulay AC, Parry D. Guide to Integrated Knowledge Translation Research. In: Graham ID, Tetroe J, Pearson A (eds). *Turning Knowledge into Action: Practical Guidance on How to Do Integrated Knowledge Translation Research*. Adelaide: Wolters Kluwer-Lippincott-JBI, 2014, pp. 176–82.
3. Cargo MD, Delormier T, Lévesque L, McComber AM, Macaulay AC. Community capacity as an "inside job": evolution of perceived ownership within a university-aboriginal community partnership. *Am J Health Promot* 2011; 26: 96–100.
4. Cargo M, Mercer SL. The value and challenges of participatory research: strengthening its practice. *Annu Rev Public Health* 2008; 29: 325–50.

5. Freire P. *Pedagogy of the Oppressed*. New York: Herder and Herder, 1970.
6. Salsberg J, Parry D, Pluye P *et al*. Successful strategies to engage research partners for translating evidence into action in community health: a critical review. *J Environ Public Health* 2015; 2015: 191856.
7. Valente TW. *Social Networks and Health: Models, Methods, and Applications*. Oxford, NY: Oxford University Press, 2010.
8. Eccles M, Foy R. Linkage and exchange interventions. In: Strauss S, Tetroe J, Graham ID (eds). *Knowledge Translation in Health Care: Moving From Evidence to Practice*. 1st edn. Wiley-BMJ Books, 2011.
9. Hogan L, García Bengoechea E, Salsberg J *et al*. Using a participatory approach to the development of a school-based physical activity policy in an Indigenous community. *J Sch Health* 2014; 84: 786–92.
10. Salsberg J, Macridis S, Garcia Bengoechea E, Macaulay AC, Moore S; Members of the KSDPP School Travel Planning Committee. Engaging community stakeholders for school-based physical activity intervention. *Retos: Nuevas Tendencias en Educación Física, Deporte y Recreación* 2015; 28: 225–31.
11. Macridis S, Garcia Bengoechea E, McComber AM, Jacobs J, Macaulay AC; Members of the Kahnawake Schools Diabetes Prevention Project-School Travel Planning Committee. Active transportation to support diabetes prevention: Expanding school health promotion programming in an Indigenous community. *Eval Program Plann* 2016; 56: 99–108.
12. Turcot V, Rouleau T, Tsopmo A *et al*. Long-term impact of an antioxidant-deficient neonatal diet on lipid and glucose metabolism. *Free Radic Biol Med* 2009; 47: 275–82.
13. Doak CM, Visscher TL, Renders CM, Seidell JC. The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. *Obes Rev* 2006; 7: 111–36.
14. Valente TW, Fujimoto K, Palmer P, Tanjasiri SP. A network assessment of community-based participatory research: linking communities and universities to reduce cancer disparities. *Am J Public Health* 2010; 100: 1319–25.
15. Leonard R, Horsfall D, Noonan K. Identifying changes in the support networks of end-of-life carers using social network analysis. *BMJ Support Palliat Care* 2015; 5: 153–59.
16. Luque JS, Tyson DM, Bynum SA *et al*. A social network analysis approach to understand changes in a cancer disparities community partnership network. *Ann Anthropol Pract* 2011; 35(2): 112–35.
17. Fuller J, Hermeston W, Passey M, Fallon T, Muyambi K. Acceptability of participatory social network analysis for problem-solving in Australian Aboriginal health service partnerships. *BMC Health Serv Res* 2012; 12: 152.
18. Carrington PJ, Scott J, Wasserman S. *Models and Methods in Social Network Analysis*. Cambridge, NY: Cambridge University Press, 2005.
19. Freeman LC. Centrality in social networks conceptual clarification. *Social networks* 1979; 1(3): 215–39.
20. Borgatti SP, Everett MG. Models of corerperiphery structures. *Social Networks* 1999; 21: 375–95.
21. Conover WJ, Iman RL. Rank transformations as a bridge between parametric and nonparametric statistics. *Am Stat* 1981; 35(3): 124–29.
22. Agresti A. *An Introduction to Categorical Data Analysis*. Vol 135: New York: Wiley, 1996.
23. Oetzel JG, Zhou C, Duran B *et al*. Establishing the psychometric properties of constructs in a community-based participatory research conceptual model. *Am J Health Promot* 2014; 29(5): e188–202.
24. Smylie J, Kaplan-Myrth N, Tait C *et al*. Health sciences research and Aboriginal communities: pathway or pitfall? *J Obstet Gynaecol Can* 2004; 26: 211–6.
25. Labonté R. Social inequality and healthy public policy. *Health Promot* 1986; 1: 341–51.