



INVESTIGATING OBESITY RELATED BEHAVIOURS IN FRIENDSHIP NETWORKS AMONG THE YOUTH: A SYSTEMISED REVIEW

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ABSTRACT

Background: Unhealthy diet, low levels of physical activity and increased participation in sedentary activities are important obesity related behaviours that negatively impact on the health of today's youth. Friends' health behaviours have been found to influence an individual's health behaviours; however, current evidence on the specific role of friendship networks on obesity related behaviours are inconclusive. The purpose of this review is to profile the existing literature in an attempt to identify the associations between friendship networks and obesity related behaviours among adolescents.

Method A systemised review of the literature was undertaken after a search of the Scopus database; a total of fifteen articles were selected for inclusion. The selected publications assessed the associations between friendship networks and obesity related behaviours (diet, physical activity, and sedentary behaviour) among youths.

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Results: There is consistent evidence that friends are similar in physical activity; evidence on diet and sedentary behaviour is mixed and limited. Friendship network characteristics seem to be associated with obesity related behaviours. Popularity (receiving ties) is likely to be associated with diet, network size, and the proportion of active friends tends to be associated with physical activity. Finally network density is associated with sedentary behaviour.

Conclusion: Friendships are critical in shaping young people's obesity related behaviour. There is extensive research investigating friendship influences on diet, physical activity and sedentary behaviour. Future studies should investigate whether friendship influence operates via other obesity related behaviours that have not yet been explored, such as sleep. Results from this review are informative for designing effective public health interventions because network based promotion interventions have a promising potential.

Keywords: Social networks, friendship, diet, physical activity, sedentary behaviour, obesity

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BACKGROUND/INTRODUCTION

Obesity is complex because it is caused by multiple genetic and environmental factors (Hernandez and Blazer, 2006). A high calorie diet, low levels of physical activity and increased participation in sedentary behaviour are all important behaviours that have contributed to the increased prevalence of obesity (Wang and Lobstein, 2006). One of the main hypothesised causes of the continued increase in obesity is that current preventative measures are individually targeted and they lack the proper understanding of obesity within the social context (i.e. the effect of social networks) (Nam et al., 2015).

The term 'social networks' refers to a set of individuals and the ties between them (Wasserman and Faust, 1994). Social networks pervade our lives on a daily basis: we interact, influence, and are influenced by our friends and acquaintances (Pinheiro et al., 2014). Christakis and Fowler were the first to find that obesity spreads over social network (Christakis and Fowler, 2007). The findings of their study were somewhat controversial as it offered evidence that obesity may spread like an infection. Several studies followed to investigate the sensitivity of Christakis and Fowler's claim, and assess the nature and extent of the person to person spread of obesity; none could dismiss their findings (Cohen-Cole and Fletcher, 2008; Bahr et al., 2009).

Christakis and Fowler's study generated significant interest where the idea of communicability (contagiousness) of obesity was originated. It is increasingly acknowledged that social networks are

vital to our understanding of obesity (Powell et al., 2015). The specific dynamic mechanisms underlying the spread of obesity remains an important gap in the literature, and is the focus of a growing body of research (Burke and Heiland, 2006; Bahr et al., 2009; Shoham et al., 2012). The social transmission of weight-related behaviours is a viable explanation for the spread of obesity in friendship networks that has been documented in recent research (Ali et al., 2011). A better understanding of the role of friendship networks on obesity related behaviours is important in order to learn how to modify these behaviours. This is especially true because, unlike genetics, obesity related behaviours (including diet, physical activity, sedentary behaviour, and sleep deprivation) are somewhat modifiable.

There are multiple processes to explain the similarity of behaviours in friendship networks. There is a process of social selection or homophile (the tendency for individuals to select individuals with similar behaviours) and peer influence (influencing the individual to change his behaviour) (Valente, 2010). Several mechanisms may explain the process of peer influence, including modelling (engaging in a behaviour after observing a peer), peer pressure (directly imposing a behaviour on a peer), group norms (a collection of attitudes shared by a group of peers) and co-participation (engaging in a behaviour with a friend) (Prinstein and Dodge, 2008). There has been a growing interest in studying the effects of social networks, including friendship networks, on obesity and

obesity related behaviours by undertaking social network analysis. Social network analysis is the structural approach based on the social ties between individuals (Freeman, 2004). The approach is focussed on the patterns and implications of the social ties between the individuals because these ties have important consequences on their behaviour (Wasserman and Faust, 1994). Social network analysis can unveil how relationships enable health behaviours (Shoham et al., 2015).

Although there is consistent evidence that friends are similar in physical activity, evidence on diet and sedentary behaviour is mixed and limited (Ali et al., 2011; Geller et al., 2013; Sawka et al., 2013). Friendship networks have been linked to obesity related behaviours; however, network characteristics have not been broadly examined (Sawka et al., 2014). There are several gaps in current knowledge, including a lack of evidence regarding the association between social network ties, roles, positions, characteristics and diet, physical activity and sedentary behaviour (Sawka et al., 2013).

The aim of this review is to synthesise existing literature on associations between friendship networks and obesity related behaviours among youths by undertaking a systemised review. A systematised review encompasses multiple, but not all, aspects of a complete systematic review (Grant and Booth, 2009). The objectives of the review are to:

1. Examine the association between a friend's obesity related behaviours (diet, physical activity and sedentary behaviour) and the obesity related behaviours (diet, physical activity and sedentary behaviour) of the individual;
2. identify different types of social network measures/variables (such as network size, density, position, etc.) and examine associations between them and obesity related behaviours (diet, physical activity and sedentary behaviour).

METHODS

To identify the relevant studies, the database Scopus was searched. The following search terms were combined for the network effects (social networks, friend, friendship, peer), and for the obesity related behaviours (diet, eating, physical activity, sedentary behaviour, screen time). Searches were restricted to English peer reviewed journal arti-

cles. Scopus was searched in August 2016. There were more than 3,000 articles returned after combining the search terms (a network effects search term and an obesity related behaviour search term were used for each search). The screening process was carried out at three different stages, including screening by title, screening by abstract and finally a full paper review. The first stage assessed the titles of the articles and, after removing the duplicates, 89 articles were eligible. The 89 remaining articles were then screened by abstract, and a total of 25 articles were identified for a full paper review. A full paper review of the remaining 25 articles resulted in 14 relevant articles, as shown in Figure 1 below. The criteria for selection were articles published in the last ten years studying the influence of social/friendship networks on obesity related behaviours among youths.

RESULTS

A total of 14 studies were included in this review. A table with a full description of the included studies is available in Appendix A. The sections below will present the findings.

Characteristics of the reviewed studies

A total of 14 articles met the inclusion criteria. The included studies were interested mainly in adolescents between the ages 12 to 18 ($n=12$), young adults aged 19 ($n=1$) and children aged 8 to 12 ($n=1$). The types of studies included literature review studies ($n=2$), primary data studies ($n=9$) and secondary data studies ($n=3$). The majority of the studies employed quantitative methods ($n=10$), and the remaining studies used mixed methods, employing both quantitative and qualitative instruments ($n=2$). The geographical locations of the studies were USA ($n=6$), Australia ($n=4$), Canada ($n=2$), United Kingdom ($n=1$) and Sweden ($n=1$). The studies followed a cross-sectional study design ($n=7$) and a longitudinal study design ($n=5$).

The selected studies that used data (both primary and secondary) investigated associations between friends/peers and one or more obesity related behaviour, in addition to associations between one or more obesity related behaviour and one or more network variable. Most of the studies investigated associations between friends or peers associations with one or more obesity relat-

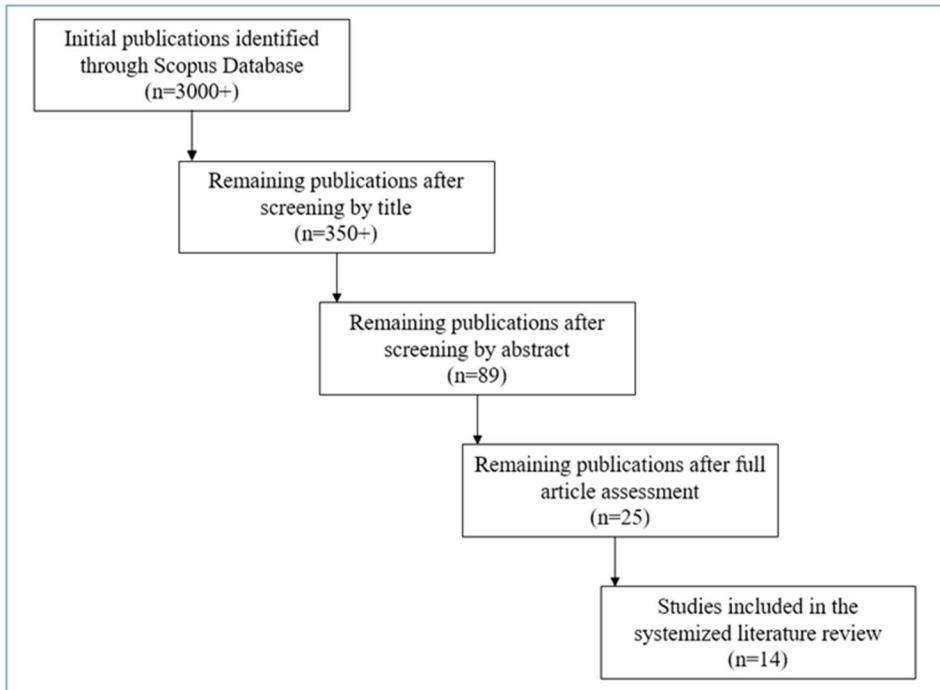


Figure 1: Diagram for article search and selection

Source: Devised by author

ed behaviour ($n=11$). The majority of the studies investigated physical activity ($n=10$), followed by diet ($n=6$) and sedentary behaviour ($n=6$). Some of the studies investigated associations between obesity related behaviours and networks variables, including size ($n=1$), density ($n=2$), popularity ($n=4$), centrality ($n=1$), clique membership ($n=2$), and proportion of friends engaging in a certain obesity related behaviour ($n=2$). This data is presented in Table 1 below.

Associations between friendship networks and diet

There is a significant positive association between individuals' and friends' fast food consumption (Ali et al., 2011). Friends having similar food consumption behaviours is a potential mechanism for the social 'contagion' of obesity (de la Haye et al., 2010). Individuals also have a significantly greater probability of eating healthily if a nominated friend does so (Barclay et al., 2013). Additionally, the degree to which this behaviour is shared is positively correlated with the strength of the relationship between both individuals (Barclay et al., 2013).

The findings of some of the studies are gender specific, which has implications for gender tailored interventions (de la Haye et al., 2010; Finnerly et al., 2009). One important friendship network property is popularity (i.e., receiving ties), which was found to be associated with consumption of unhealthy snacks among males; this means that popular boys were the highest consumers of unhealthy snacks (de la Haye et al., 2010), as shown in Table 2 below. Male friends were also found to be similar in their consumption of high calorie foods (de la Haye et al., 2010). Although adolescent intake of unhealthy foods was predicted by their friends' intake, the changes to adolescents' beliefs about unhealthy foods do not appear to be the underlying mechanism of influence from their friends (de la Haye et al., 2013).

There seems to be mixed evidence on peer and friends' influences on individuals in the literature. Some researchers found no evidence of peer or friend influence on individuals' dietary habits (Finnerly et al., 2009; Geller et al., 2013). Parents/guardians had more influence on adolescents' dietary behaviours in comparison to their friends (Geller et al., 2013).

Table 2 Studies investigating associations between friends/peers, obesity related behaviours and network variables

Publication	Association between friends/peers			Obesity related Behaviour			Network Variable				
	Diet	Physical Activity	Sedentary behaviour	Size	Density	Popularity	Centrality	Clique membership	Proportion of friends		
Ali et al., 2011	✓	✓	✓								
Barclay et al., 2013	✓	✓									
de la Haye et al., 2010	✓	✓	✓	✓	✓				✓		
de la Haye et al., 2011	✓	✓									
de la Haye et al., 2013	✓					✓					
Finnerty et al., 2009	✓	✓									
Garcia et al., 2016	✓	✓	✓								
Geller et al., 2013	✓	✓	✓								
Marks et al., 2015	✓	✓	✓						✓		
Sawka et al., 2014	✓	✓	✓	✓	✓	✓	✓		✓		
Simpkins et al., 2013	✓	✓	✓			✓			✓		

Source: Devised by authors

Associations between friendship networks and physical activity

There is significant positive association between individuals' and friends' sports and exercise (Ali et al., 2011). Individuals tended to befriend friends who did similar amounts of physical activity and consequently emulated their friends' behaviours (de la Haye et al., 2011). Friends' physical activity levels have a major influence on individual's physical activity levels (Sawka et al., 2013). Higher levels of friends' moderate to vigorous physical activity (MVPA) was associated with higher levels of MVPA among males and females (Garcia et al., 2016). There is a mutually dependent relationship between physical activity and adolescent friendship networks (de la Haye et al., 2011). Friends become similar in BMI and physical activity over time. Physical activity was not found to explain friendship similarity on BMI, but several other potential mechanisms could provide an explanation (Simpkins et al., 2013). Focus group data showed that friends positively influenced participants' physical activity through engaging in activities with participants, verbal encouragement, and modelling; the most cited reason for engaging in physical activity with friends was enjoyment (Garcia et al., 2016). Children's physical activity was positively associated with friends' encouragement, friends' own physical activity and engagement with friends in physical activity (Maturro and Cunningham, 2013). Different friendship network characteristics were found to have different consequences on physical activity; the proportion of active close friends was associated with physical activity (Sawka et al., 2014). Additionally the size of children/

adolescents' friendship groups is associated with physical activity (de la Haye et al., 2010), as shown below in Table 2.

Associations between friendship networks and sedentary behaviour

Evidence surrounding friendship influence on individual sedentary behaviour is limited and mixed (Sawka et al., 2013). There is no consistent evidence to support peer effects on TV viewing (Ali et al., 2011). One study found female friends to engage in similar screen based behaviours (de la Haye et al., 2010). Another study found that males screen time was associated with higher levels of screen time among their friends (Garcia et al., 2016). Friendship network characteristics were found to be associated with sedentary/screen time in late childhood/early adolescence; however, these associations differ by gender (Marks et al., 2015). Different friendship network characteristics appeared to have different consequences on sedentary behaviour; network density was associated with sedentary behaviour among boys, so boys in dense networks were found to be highly sedentary (Sawka et al., 2014) as shown below in Table 2.

DISCUSSION

There are strong associations between peers' health behaviours for youths, which suggests that health behaviours of an individual's peers play an important role in shaping their own health behaviours (Barclay et al., 2013). A higher BMI of close

Table 2 Studies that found evidence for associations between friends/peers, network variables and obesity related behaviours

Obesity Related Behaviour	Association between friends/peers	Network Variable			
		Size	Density	Popularity	Proportion of friends
Diet	Ali et al., 2011, Barclay, Edling and Rydgren, 2013			(de la Haye et al., 2010)	
Physical Activity	Ali et al., 2011, de la Haye et al., 2011, Garcia et al., 2016, Sawka et al., 2014	de la Haye et al., 2010			Sawka et al., 2014
Sedentary Behaviour	de la Haye et al., 2010, Garcia et al., 2016		Sawka et al., 2014		

Source: Devised by authors

friends is correlated with a higher BMI of the individual (Renna et al., 2008). One of the hypothesised causes of the similarities in higher BMI among friends is the similarities in obesity related behaviours; these include diet, physical activity and sedentary behaviour. Peers and friends are found to have a significant effect on physical activity levels (Finnerty et al., 2009).

When it comes to diet, there are mixed findings in the literature on the similarities in diet among friends. Some researchers found similarities in diet among friends (healthy and unhealthy diets) (Ali et al., 2011; de la Haye et al., 2010, 2013; Barclay et al., 2013), whereas others found no effect of friends on individuals diet (Finnerty et al., 2009; Geller et al., 2013).

Evidence surrounding friendship influence on individual sedentary behaviour is also limited and mixed (Sawka et al., 2013). This offers important implications for designing promotion interventions and obesity prevention programmes (Finnerty et al., 2009). Network-based strategies may be effective in supporting individuals to be physically active (de la Haye et al., 2010). Adolescents were found to be responsive to the body weight of friends with the same gender (Renna et al., 2008); there is also, therefore, a need for gender specific interventions (Finnerty et al., 2009).

Friendship network characteristics are associated with some obesity related behaviours; however, these associations differ by gender (Marks et al., 2015). Different friendship network characteristics (density, proportion of active friends; betweenness centrality, popularity) appeared to have different consequences on diet, physical activity and sedentary behaviour. Popularity (receiving ties) was associated with the consumption of unhealthy snacks among boys, the proportion of active close friends was associated with higher levels of physical activity among boys and girls, finally, network density was associated with sedentary behaviour among boys (de la Haye et al., 2010; Sawka et al., 2014).

Friendships networks have been linked to obesity related behaviours; however, network characteristics have not been extensively examined (Sawka et al., 2014).

CONCLUSIONS

A high calorie diet, lower levels of physical activity and increased participation in sedentary behav-

our are all important behaviours that have contributed to the increased prevalence of obesity (Wang and Lobstein, 2006). The spread of obesity related behaviours is a potential mechanism by which obesity may spread over friendship networks (Ali et al., 2011). A growing body of literature explored associations between friendship network characteristics, diet physical activity, and sedentary behaviours (de la Haye et al., 2010; Garcia et al., 2016; Geller et al., 2013; Marks et al., 2015; Renna et al., 2008; Sawka et al., 2013; Sawka et al., 2014).

Friendship networks have been linked to obesity related behaviours; however, network characteristics have not been extensively examined (Sawka et al., 2014). Also, there is evidence that friends influence an individuals' physical activity levels; the evidence is less clear for diet and sedentary behaviours (de la Haye et al., 2011; Geller et al., 2013; Sawka et al., 2013). More investigative research is necessary to clarify the role of friendship networks on diet and sedentary behaviour.

Future studies in different cultural contexts and different clinical samples are required (Tonetti et al., 2014). Future studies should also investigate whether friendship networks influence obesity via other pathways (Ali et al., 2011). Sleep deprivation (an important predictor of obesity) has generally been neglected in the social networks literature (Maume, 2013).

Results from this review are informative for designing effective interventions that could utilise the influence of friends to increase physical activity levels among children, adolescents and young adults.

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BIOGRAPHICAL NOTES

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