



Mini Review

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The Impact of Social Support Groups on Outcomes in Adult Patients with Type 2 Diabetes Attending Tenwek Hospital, in Bomet County



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Abstract

Diabetes is one of the fastest growing chronic diseases globally and in the United States. Although preventable, type 2 diabetes accounts for 90% of all cases of diabetes worldwide and continues to be a source of increased disability, lost productivity, mortality, and amplified healthcare costs. Proper disease management is crucial for achieving better diabetes-related outcomes. Evidence suggests that higher levels of social support are associated with improved clinical outcomes, reduced psychosocial symptomatology, and the adaptation of beneficial lifestyle activities; however, the role of social support in diabetes management is not yet well understood. The main purpose of this study is to explain and evaluate the influence of support groups and identity on goal setting and achievement in persons with type 2 diabetes. 100 hundred type 2 diabetic patients were interviewed. A structured interviewer-administered questionnaire was used to collect data. This is a descriptive study, and the data was keyed into excel. The researcher used percentages, tables and bar graphs to analyze the collected data and gave interpretations upon conclusion. Social support was associated with more optimal self-care and self-reported HbA1c outcomes. When diabetes-specific self-efficacy and distress were included as mediators, the direct path from social support became non-significant. Conversely, the indirect effects of social support through diabetes-specific self-efficacy and distress were significant across all diabetes groups and outcomes. Diabetes-specific self-efficacy and distress may be important mechanisms linking social support with diabetes self-care and clinical outcomes. Diabetes-specific self-efficacy and distress could help improve self-care.

Keywords: Diabetes; Social support; Self-care; Diabetes distress; Self-efficacy; Health behaviour

Introduction

Burden of Diabetes

Diabetes is one of the most prevalent and fastest-growing chronic illnesses, globally affecting more than 346 million people worldwide (World Health Organization: 10 facts about diabetes 2011). It is emerging as a global epidemic due to the rapid increase in overweight, obesity, and physical inactivity. (World Health Organization: 10 facts about diabetes 2011). The combined impact of poor awareness, insufficient access, limited services, and inadequate resources makes diabetes the leading cause of blindness, amputation, and kidney failure worldwide. (World Health Organization: 10 facts about diabetes 2011).

Cardiovascular disease (CVD) accounts for 50%-80% of deaths in people with diabetes, a number expected to rise by more than 50% in the next 10 years (World Health Organization: 10 facts about diabetes 2011). For these reasons, diabetes has become a major cause of premature illness and death in most countries and is predicted to become the seventh leading cause of death in the world by 2030. (World Health Organization: 10 facts about diabetes 2011). Additionally, diabetes accounted for 11.6% of total healthcare expenditure in 2010 (International Diabetes Federation 2011). Estimated global healthcare expenditures to treat and prevent diabetes and its complications are expected to exceed US\$490 billion by 2030; this equals approximately \$561

billion (international dollars) by 2030(International Diabetes Federation2011).

Currently in the U.S., 25.8 million people (or 8.3% of the population) have diabetes, and 7.0 million are still undiagnosed (Centers for Disease Control and Prevention; Atlanta, GA: 2011). Nearly 1.9 million people 20 years of age or older were newly diagnosed with diabetes in 2010 in the U.S.; an estimated 79 million adults 20 years of age or older have pre-diabetes (Centers for Disease Control and Prevention; Atlanta, GA: 2011). Men and minorities-non-Hispanic Blacks, Hispanics (Mexican Americans, Puerto Ricans, and Cubans), and American Indians/Native Americans/Pacific Islanders-are more affected, as compared with women and non-Hispanic Whites, respectively (American Diabetes Association 2011). As has been observed globally, diabetes is the leading cause of complications, including heart disease and stroke, kidney failure, and no - traumatic lower-limb amputations (American Diabetes Association 2011). It is the cause of new cases of blindness among adults in the U.S. and, according to 2007 estimates, is the seventh leading cause of death in the U.S (American Diabetes Association). Regrettably, people diagnosed with diabetes have twice the risk of death of people of similar age without diabetes (Centers for Disease Control and Prevention; Atlanta, GA: 2011). Given the vast number of people affected by this chronic disease, the total estimated costs for diabetes in the U.S. are \$174 billion annually. (Centers for Disease Control and Prevention; Atlanta, GA: 2011).

Although preventable, type 2 diabetes (T2DM) accounts for 90% of all cases of diabetes worldwide (Centers for Disease Control and Prevention; Atlanta, GA: 2011). Evidence shows that at least 30 min of moderate exercise, along with healthy eating habits, aids in preventing and managing diabetes and diabetes-related outcomes (Centers for Disease Control and Prevention; Atlanta, GA: 2011). These behaviours, in addition to other self-care activities such as home blood glucose monitoring, taking medications as prescribed, obtaining preventive services, and limiting alcohol intake and tobacco use, make living and adjusting to a life with diabetes more manageable. Self-management of T2DM, however, requires the assistance of multiple sources of support groups. (World Health Organization: 10 facts about diabetes 2011).

Although new treatments and technology have aided in controlling the disease in many individuals, the challenges of diabetes self-management are overwhelming for most. Diabetes is a chronic disease for which control demands patient self-management (Diabetes Educator 2007; 33: 139S-144S).Self-management behaviours include monitoring blood glucose levels, taking medication, maintaining a healthy diet and regularly exercising. For most patients, it is important to conduct daily foot exams. However, despite the technological and scientific advances made toward the treatment of diabetes, the American Association of Clinical Endocrinologists (2005) reports that only 1 in 3 patients with type 2 diabetes is well controlled. The American Association of Diabetes Educators suggests that only one-half of

patients adhere to medication. There are relatively high levels of non-adherence in all areas of self-management behaviours. This non-adherence is perhaps due to the fact that self-management behaviours usually require changes in the patient's daily life. (American Association of Diabetes Educators.2004)

Results

Introduction

The results of the research project exploring the impact of social support groups on the outcome among type two diabetic patients are reported in this chapter. The analysis results are presented per study objectives and described in tables, bar charts and pie charts. The sample size for the analysis was 50 clients who are support group users and 50 who do not support group users. Qualitative data was collected and keyed in MS-excel database

Social-Demographic Characteristics

Table 1: Descriptive statistics of demographic information for Support group users.

Age (N=50)	18-24	3	6%
	25-34	4	8%
	35-44	10	20%
	45-54	10	20%
	55-64	10	20%
	65+	13	26%
Gender (N=50)	male	23	46%
	female	27	54%
Education (N=50)	primary	4	8%
	secondary	36	72%
	tertiary	10	20%
Marital status (N=50)	married	40	80%
	Single	5	10%
	separated	0	0%
	divorced	0	0%
	widowed	5	10%

Table 1 below shows descriptive statistics of demographic information for support group users. The table 2 below shows age in years, gender, level of education and marital status. The respondents among support group users (n=50) were 46% male (n=23) and 54% (n=27) female. All age ranges were represented, however, the majority of the population was over the age of 35. Six per cent (n=3) of the population were aged 18-34, 18% of the population (n=10) were aged 35-44, 20% of the population (n=10) were aged 45-54, 20% of the population (n=10) were aged 55-64 and 20% of the population (n=13) was over the age of 65. The majority of the population was married (n=43), six per cent were single (n=5), none were separated nor divorced and five respondents were widowed. The educational background of the

respondents varied; the majority of the respondents had completed high school (n=20).

Table 2: Descriptive statistics of demographic information for non- Support group users.

Age (N=50)	18-24	3	6%
	25-34	4	8%
	35-44	9	18%
	45-54	11	22%
	55-64	12	24%
	65+	11	22%
Gender (n=50)	male	24	48%
	female	26	52%
Marital status (n=50)	married	43	86%
	single	3	6%
	separated	0	0%
	divorced	0	0%
	widowed	4	8%
Education (n=50)	primary	15	30%
	Secondary	20	40%
	Tertiary	15	30%

(n=50) was 48% male (n=23) and 52% (n=27) female. All age ranges were represented, however, the majority of the population was over the age of 35. Six per cent (n=3) of the population were aged 18-34, 18% of the population (n=9) were aged 35-44, 22% of the population (n=11) were aged 45-54, 24% of the population (n=12) were aged 55-64 and 22% of the population

(n=11) was over the age of 65. The majority of the population was married (n=43), six per cent were single (n=5), none were separated nor divorced and five respondents were widowed. The educational background of the respondents varied; a majority of the respondents had completed high school (n=20) (Figure 1&2).

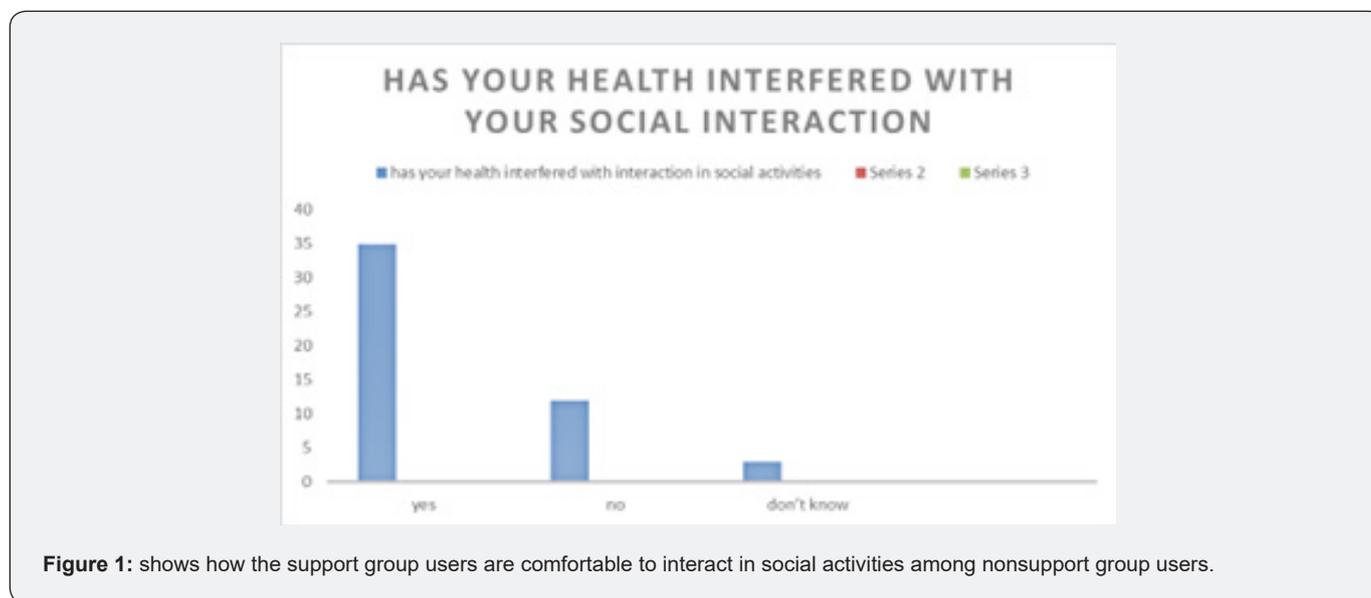


Figure 1: shows how the support group users are comfortable to interact in social activities among nonsupport group users.

Non-Support Group User and Ability to Interact in Social Activities

Most non-support group users 70% were not able to interact in social events comfortably and to interact with others comfortably.

Nevertheless, some of the respondents were able to interact well with others in social activities very few of the respondents had no idea whether their health interfered with their social activities. 4.5 interaction between health and hobbies for support group user (Figure 3).

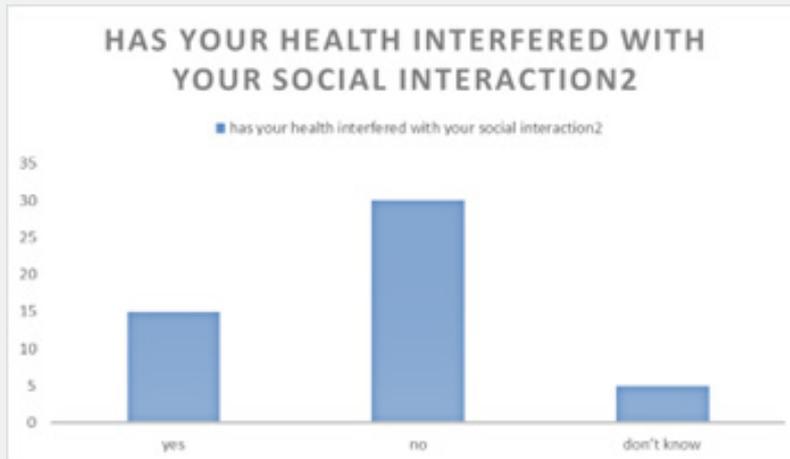


Figure 2: Shows health interaction among support group users.



Figure 3: interaction of health and hobbies for support group users.



Figure 4: interaction of health and hobbies for support group users. General health and diabetes symptoms.

Figure 3 above shows that most of the support group users 60% were able and happy to continue with their hobbies despite their health problems 34 % could not participate in their hobbies

and 6 % were not sure if they could still participate in their hobbies (Figure 4)



Figure 4: interaction of health and hobbies for support group users. General health and diabetes symptoms.

General health and diabetes symptoms (Figure 5-7).

% had dry mouth and 16% didn't know if they had a dry mouth (Figure 8).

Majority of the respondents didn't have dry mouth 80% 4

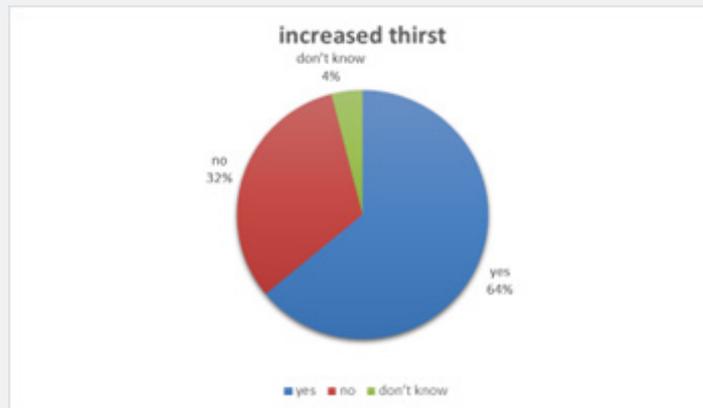


Figure 5: Shows the symptoms of type two diabetes among support group users.

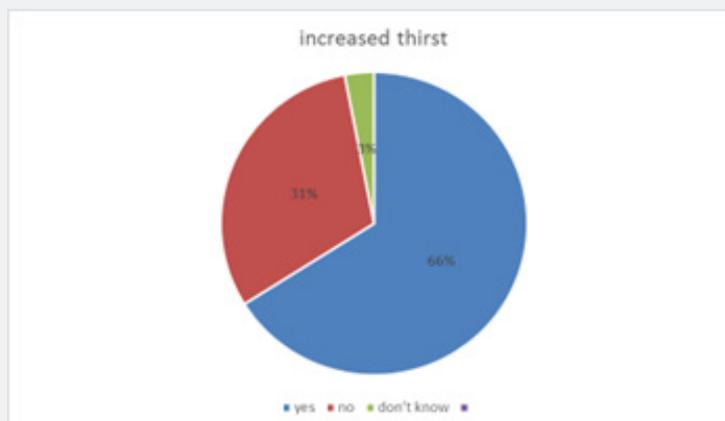


Figure 6: Respondents who had increased thirst among support group users.



Figure 7: Shows the respondents who had dry mouth support group users.

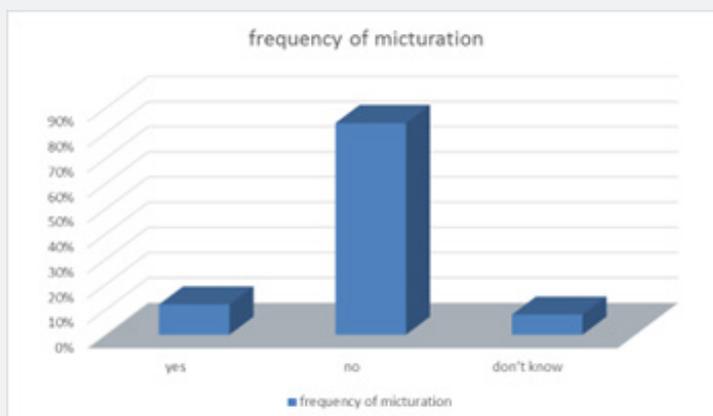


Figure 8: Frequency of Micturation.

Discussion of Results

The present study contributes to a better understanding of the role of patient support groups in the self-management of type 2 diabetes. The concept of identity has often been used to understand goal behaviours in the workplace and has been slowly introduced into the healthcare environment to understand how individuals cope with chronic illness. Healthcare providers are in a unique position to implement theory-based interventions or strategies to improve patient-reported outcomes. This study examines how individuals identify with and behave as part of, social groups. Within this theoretical framework, group identification has been found to be positively related to improved effort and motivation of the individual to attain goals. Individuals in the study could identify with a specific support group, or a more abstract collectivity of all individuals with type 2 diabetes in Bomet County.

Discussion of the Demographic Results

When we look at the demographic data we see that type 2 diabetes impacts men and women proportionately. The

demographic characteristics of the participants completing both versions of the survey show that the majority of respondents in both populations (52% of non-support group users and 54% of support group users) were female (Tables 4.1 and 4.2). Our study sample had more females, which is not surprising because when we examine support group participants, we see that there tend to be more women than men in such groups. In a study conducted by the Pew Research Center on Internet use, it was found that over 90 million individuals have participated in an online group of some form. When we examine the results of support groups, the study reports that women tend to seek support for illness more so than men and are more likely than men to have more interactive relationships [1,2]. Such findings, with respect to participation and interaction, have also been observed within online social networking sites, such as Facebook® and LinkedIn® [3]. Another study found evident differences between genders with respect to types of interactions in support groups; reporting that men tend to give and receive information related to their condition, while women tend to give and receive encouragement and support [4]. Other studies on self-help show that men are more likely

than women to use self-help groups (i.e. Alcoholics Anonymous) [5]. This study by Davion and colleagues included other support groups, including those for chronic illness, however, the largest subset of the population was the substance abuse groups. Our findings suggest that both men and women in this particular study have the same level of need with respect to support groups as others [6-9].

When we compare the two study groups, we found the only statistically significant differences were age and sex. Respondents in the support group were significantly older than respondents in the non-support group; the majority of the support group respondents were 45 and older. The majority of the population had some high school education, and the support group participants were slightly more educated [10,11].

Health Impact on the Emotion

There are many significant differences between support group users and those that are not in a support group. These differences are with respect to certain diabetes control attitudes, the support of family and friends, negative emotions related to or as a result of being a person with diabetes, the impact that diabetes has on one's life (both present and future abilities), the strength of all lifestyle goals and related goal self-efficacy and achievement. Recommendations for care made by the provider may make the patient feel unable to exercise any control in their care. Examination of the types of topics that are posted within the support group community reveals that many members question the recommendations of their healthcare provider and seek confirmation or disconfirmation from other members, and the majority of these instances of doubt involve medication use.

Support group members may have different personalities than those that do not belong to support groups. Characteristics such as graciousness, holistic, and participative might be used to describe such patients. This perception of unease might be related to an individual's rationale to join a support group and seek the support and understanding of other individuals that have diabetes. This finding may suggest that individuals who experience heightened negative emotions have an illness identity that is more salient and thus might affect their social relationships with others. These individuals might relate more with other persons with diabetes. These individuals might also identify themselves as belonging to a larger group of persons with diabetes because being one of many is deemed better than being alone. To preserve self-esteem this mentality is adopted.

Impact of the Health Problem on Social Interaction

The respondents were examined on the effect of diabetes type 2 on their ability to interact in various social activities as shown in the data collected in this study. Most non-support group users, 70%, were not able to comfortably interact in social events and to interact with others comfortably compared with support group users where the majority of the respondents had no problem

participating in daily social events and interacting with others. Figure 4.6 in chapter 4 shows that most of the support group users 60% were able and happy to continue with their hobbies despite their health problems 34 % could not continue with their hobbies and 6 % were not sure if they could still participate in their hobbies. Concerning general health, 50% of support group users were in excellent health compared to 44% of nonsupport group users. The study also shows in Table 5.2 for support group users most support group users 60% had a glucometer machine and were able to measure their blood glucose at home compared to 40% of nonsupport group users. 86% of support group users were adherent to their medication and 14% missed to take their medication in the past 1 month probably because of education in social support groups. most of the respondents were adherent to their medication at (n=43) 86% compared to (n=32) 64% in non-support group users. Also, the act of taking medication, as described in other studies included in Chapter 2, is sometimes viewed as a failure, or an option of last resort when lifestyle changes are not effective. Therefore, patients might experience a decrease in self-efficacy when a particular medication they are on suddenly becomes ineffective or when they are switched from oral medications to insulin. In this particular study population, all subjects were on some form of medication.

Conclusion and Recommendation

Diabetes is a disease that can be very individualistic in the sense that it can differentially impact different individuals based on race, socioeconomic status, age and even gender. Illness severity, treatment strategies and comorbidities all contribute to a different experience for every patient. As such, using the experience of one patient to make assumptions about another with respect to treatment can be misinformed. That is why the information that is presented within support groups must be carefully reviewed by a healthcare professional and moderated so that it is not misconstrued. Peer information, while having an experiential component that family support lacks, is often provided from the viewpoint of one individual and his or her experience.

Without fully understanding how illness severity and comorbidities may play a role in determining treatment strategies, the individual may assert that because a particular treatment worked for them, it will work for others. The patient, then armed with this information, and perhaps more information (not always peer-reviewed) gleaned from an additional search, begins to question the recommendations of his or her healthcare provider. This questioning can result in two different scenarios: in one, the patient consults his or her healthcare provider with the information and dialogue about the information can occur. Oftentimes, the health care provider may spend an inordinate amount of time explaining why the particular treatment would not be effective for the patient when compared to what the patient is currently taking/doing to manage his or her diabetes, and thus

can be viewed as an inefficient use of time in the health care encounter. In the second scenario, there is no communication between the patient and the provider and the patient may opt to stop following the healthcare provider's recommendations and thus becomes non-compliant. This noncompliance may result in a multitude of adverse events for the patient, further jeopardizing his or her health.

Finally, this study sought to measure the influence of identity and support on one outcome: lifestyle and medication goal achievement. Future research should determine if support group participants are able to achieve benefits beyond goal achievement, such as quality of life, improved health and improved identity. More investigation is needed to determine if online support is effective in assisting people to achieve such outcomes and how to create interventions that supplement traditional healthcare provision for chronically ill patients that use online support to improve outcomes.

References

- Almeida LR, Martins AR, Fernandes EM, Oliveira MB, Correló VM, et al. (2013) New biotextiles for tissue engineering: development, characterization and in vitro cellular viability. *Acta Biomater* 9(9): 8167-8181.
- Sant S, Iyer D, Gaharwar AK, Patel A, Khademhosseini A, et al. (2013) Effect of biodegradation and de novo matrix synthesis on the mechanical properties of valvular interstitial cell-seeded polyglycerol sebacate-polycaprolactone scaffolds. *Acta Biomater* 9(4): 5963-5973.
- Zahedi P, Rezaeian I, Ranaei-Siadat SO, Jafari SH, Supaphol P, et al. (2010) A review on wound dressings with an emphasis on electrospun nanofibrous polymeric bandages. *Polym Adv Technol* 21(2): 77-95.
- Sumanasinghe RD, King MW (2003) *J Text Appar Technol Manag* 3: 1-13.
- Coyle S, Wu Y, Lau KT, De Rossi D, Wallace G, et al. (2007) Smart Nanotextiles: A Review of Materials and Applications. *MRS Bull* 32: 434-442.
- Altman GH, Diaz F, Jakuba C, Calabro T, Horan RL, et al. (2003) Silk-based biomaterials. *Biomaterials* 24(3) 401-416.
- Vepari C, Kaplan DL (2007) Silk as a Biomaterial. *Prog Polym Sci* 32(8-9): 991-1007.
- Zhang YQ, Tao ML, Shen WD, Mao JP, Chen Yh, et al. (2006) *J Chem Technol Biotechnol* 81: 136-145.
- Hardy JG, Scheibel TR (2010) Composite materials based on silk proteins. *Prog Polym Sci* 35(9): 1093-1115.
- Zhang YQ, (2002) Applications of natural silk protein sericin in biomaterials. *Biotechnol Adv* 20(2): 91-100.
- Bayram C, Demirbilek M, Yalçın E, Bozkurt M, Doğan M, et al. (2014) *Appl Surf Sci* 288: 143-148.
- Wharram SE, Zhang X, Kaplan DL, McCarthy SP (2010) *Macromol Biosci* 10: 246-257.
- Kundu J, Mohapatra R, Kundu S (2011) Silk fibroin/sodium carboxymethylcellulose blended films for biotechnological applications. *J Biomater Sci Polym Ed* 22(4-6): 519-539.
- Pruitt BA, McManus AT, Kim SH, Goodwin CW (1998) *World J Surg* 22: 135-145.
- Kong HH (2011) Skin microbiome: genomics-based insights into the diversity and role of skin microbes. *Trends Mol Med* 17(6): 320-328.
- Torres-Giner S, Ocio M, Lagaron J (2008) Development of Active Antimicrobial Fiber-Based Chitosan Polysaccharide Nanostructures using Electrospinning. *Eng Life Sci* 8(3): 303-314.
- Ignatova M, Starbova K, Markova N, Manolova N, Rashkov I, et al. (2006) Electrospun nano-fibre mats with antibacterial properties from quaternised chitosan and poly (vinyl alcohol). *Carbohydr Res* 341(12): 2098-2107.
- Xu X, Yang Q, Wang Y, Yu H, Chen X, et al. (2006) *Eur Polym J* 42(): 2081-2087.
- Son WK, Youk JH, Lee TS, Park WH (2004) *Macromol. Rapid Commun* 25: 1632-1637.
- Anitha A, Brabu B, Thiruvadigal DJ, Gopalakrishnan C, Natarajan T, et al. (2012) Electrospun zein nanofibers incorporating cyclodextrins. *Carbohydr Polym* 87: 1065-1072.
- Rajendra R, Balakumar C, Ahammed HAM, Jayakumar S, Vaideki K, et al. (2010) Use of zinc oxide nano particles for production of antimicrobial textiles. *Int J Eng Sci Technol* 2(1): 202-208.
- Chen L, Bromberg L, Hatton TA, Rutledge GC (2008) *Polymer* 49: 1266-1275.
- Scaffaro R, Botta L, Sanfilippo M, Gallo G, Palazzolo G, et al. (2013) Combining in the melt physical and biological properties of poly(caprolactone) and chlorhexidine to obtain antimicrobial surgical monofilaments. *Appl Microbiol Biotechnol* 97(1): 99-109.
- Gibney KA, Sovadinova I, Lopez AI, Urban M, Ridgway Z, et al. (2012) Poly(ethylene imine)s as antimicrobial agents with selective activity. *Macromol Biosci* 12(9): 1279-1289.
- Ren G, Hu D, Cheng EW, Vargas-Reus MA, Reip P, et al. (2009) Characterisation of copper oxide nanoparticles for antimicrobial applications. *Int J Antimicrob Agents* 33(6): 587-590.
- Hernández-Sierra JF, Ruiz F, Cruz Pena DC, Martínez-Gutiérrez F, Martínez AE, et al. (2008) The antimicrobial sensitivity of *Streptococcus mutans* to nanoparticles of silver, zinc oxide, and gold. *Nanomedicine* 4(3): 237-240.
- Stanić V, Dimitrijević S, Antić-Stanković J, Mitrić M, Jokić B, et al. (2010) Synthesis, characterization and antimicrobial activity of copper and zinc-doped hydroxyapatite nanopowders. *Appl Surf Sci* 256(20): 6083-6089.
- Rai M, Yadav A, Gade A (2009) Silver nanoparticles as a new generation of antimicrobials. *Biotechnol Adv* 27(1): 76-83.
- Ahamed M, Karns M, Goodson M, Rowe J, Hussain SM, et al. (2008) DNA damage response to different surface chemistry of silver nanoparticles in mammalian cells. *Toxicol Appl Pharmacol* 233(3): 404-410.
- Park MVDZ, Neigh AM, Vermeulen JP, de la Fonteyne LJJ, Verharen HW, et al. (2011) The effect of particle size on the cytotoxicity, inflammation, developmental toxicity and genotoxicity of silver nanoparticles. *Biomaterials* 32(36): 9810-9817.
- Beyth N, Yudovin-Farber I, Bahir R, Domb AJ, Weiss EI, et al. (2006) Antibacterial activity of dental composites containing quaternary ammonium polyethyleneimine nanoparticles against *Streptococcus mutans*. *Biomaterials* 27(21): 3995-4002.
- Kenawy ER, Worley SD, Broughton R (2007) The chemistry and applications of antimicrobial polymers: a state-of-the-art review. *Biomacromolecules* 8(5): 1359-1384.
- Lee HJ, Lee SG, Oh EJ, Chung HY, Han SI, et al. (2011) Antimicrobial polyethyleneimine-silver nanoparticles in a stable colloidal dispersion. *Colloids Surf. B: Biointerfaces* 88(1): 505-511.

34. Lin J, Qiu S, Lewis K, Klibanov AM (2002) Bactericidal properties of flat surfaces and nanoparticles derivatized with alkylated polyethylenimines. *Biotechnol Prog* 18(5): 1082-1086.
35. Milovi NM, Wang J, Lewis K, Klibanov AM (2005) Surpassing nature: rational design of sterile-surface materials. *Biotechnol Bioeng* 90: 715-722.
36. Jeon O, Yang HS, Lee TJ, Kim BS (2008) *J Control Release* 132: 236-242.
37. Fortune JA, Novobrantseva TI, Klibanov AM (2011) Highly Effective Gene Transfection *In Vivo* by Alkylated Polyethyleneimine. *J Drug Deliv*, pp. 1-6.
38. Fang X, Xiao S, Shen M, Guo R, Wang S, et al. (2011) Fabrication and characterization of water-stable electrospun polyethyleneimine/polyvinyl alcohol nanofibers with super dyesorption capability. *New J Chem* 35(2): 360-368.
39. Khanam N, Mikoryak C, Draper RK, Balkus KJ (2007) *Acta Biomater* 3: 1050-1059.
40. Sill TJ, Recum HA (2008) Electrospinning: applications in drug delivery and tissue engineering. *Biomaterials* 29(13): 1989-2006.
41. Xiao ZS, Yanchun L, Palumbo FS, Luo Y, Prestwich GD, et al. (2004) In situ crosslinkable hyaluronan hydrogels for tissue engineering. *Biomaterials* 25(7-8): 377-383.
42. Li X, Liu H, Zhou G, Fan GH, Fan Y, et al. (2011) *Biomaterials* 32: 3784-3793.
43. Malmsten M, Davoudi M, Schmidtchen A (2006) Bacterial killing by heparin-binding peptides from PRELP and thrombospondin. *Matrix Biol* 25(5): 294-300.
44. Son WK, Youk JH, Lee TS, Park WH (2004) The Effects of Solution Properties and Polyelectrolyte on Electrospinning of Ultrafine Poly(Ethylene Oxide) Fibers. *Polymer* 45: 2959-2966.
45. Xu X, Zhang JF, Fan Y (2010) Fabrication of cross-linked polyethyleneimine microfibers by reactive electrospinning with in situ photo-cross-linking by UV radiation. *Biomacromolecules* 11(9): 2283-2289.
46. Destaye AG, Lin CK, Lee CK (2013) Glutaraldehyde vapor cross-linked nanofibrous PVA mat with in situ formed silver nanoparticles. *ACS Appl Mater Interfaces* 5(11): 4745-4752.
47. Wang M, Jin HJ, Kaplan DL, Rutledge GC (2004) Health & Environmental Research Online (HERO). *Macromolecules* 37(18): 6856-6864.
48. Wenk E, Murphy AR, Kaplan DL, Meinel L, Merkle HP, et al. (2010) The use of sulfonated silk fibroin derivatives to control binding, delivery and potency of FGF-2 in tissue regeneration. *Biomaterials* 31(6) 1403-1413.
49. Gölander CG, Eriksson JC (1987) *Journal of Colloid and Interface Science. J Colloid Interface Sci* 119: 38-48.
50. Hofmann S, Wong Po Foo C, Rossetti F, Textor M, Vunjak-Novakovic G, et al. (2006) Silk fibroin as an organic polymer for controlled drug delivery. *J Control Release* 111(1-2): 219-227.
51. Ren S, Yang S, Zhao Y, Yu T, Xiao X, et al. (2003) *Surf Sci* 546: 64-74.
52. Moghimi SM, Symonds P, Murray JC, Hunter AC, Debska G, et al. (2005) A two-stage poly(ethyleneimine)-mediated cytotoxicity: implications for gene transfer/therapy. *Mol Ther* 11(6): 990-995.
53. Xia B, Dong C, Lu Y, Rong M, Lv YZ, et al. (2011) *Thin Solid Films* 520: 1120-1124.
54. Wiegand C, Bauer M, Hipler UC, Fischer D (2013) Nitric oxide integrated polyethyleneimine-based tri-block copolymer for efficient antibacterial activity. *Int J Pharm* 456: 165-174.
55. Semih Ç, Erdoğan C, Özalp M, Ulubayram K (2014) *Materials Science and Engineering C*.



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