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Physical activity in persons with diabetes: its relationship with media use for health information, socioeconomic status and age

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Abstract

Although low socio-economic status (SES) persons with diabetes show low levels of physical activity (PA), there is limited knowledge regarding which media is effective in improving their PA. This study aimed to determine the appropriate media for providing PA-related information to persons with diabetes in low SES compared with those in high SES. The data of 770 persons with diabetes in low or high SES were extracted from Multimedia Audience Research Systems 2013, a nationwide cross-sectional study. The relationships among media use for health information (i.e. magazine, television and Internet use), PA, and high and low SES were examined using regression analysis. Additional analysis was conducted to examine whether the above relationships differ by age, which influences the use of media. The relationships of media use for health information with PA levels varied by SES; while television use was associated with increased PA levels, Internet use was associated with decreased PA levels in older, low SES persons with diabetes. The findings indicated that television can be a useful resource to provide PA-related information to low SES persons with diabetes and suggest the significance of choosing appropriate media to provide PA-related information for them.

Introduction

Physical activity (PA) is critical for persons with diabetes to optimize health outcomes [1]. Moderate levels of PA assist persons with diabetes with maintaining optimal blood glucose levels by increasing glucose uptake into muscles [2] and strenuous levels of PA improve their cardiorespiratory fitness [3]. Moreover, as a long-term practice, PA reduces the risk of diabetic complications, such as cardiovascular diseases and kidney failure [4], and decreases healthcare utilization and costs [5]. Socioeconomic status (SES) is one of the contributing factors to PA. SES refers to 'the social and economic factors that influence what positions individuals or groups hold within the structure of a society' [6]. Family/household income and education have often been used as indicators of SES [6, 7]. For example, low SES individuals refer to those with low educational attainment, such as less than and equal to a high school diploma, and low family/household income below the official poverty level defined by the US Department of Health and Human Services poverty guidelines [7].

Persons with diabetes who have low SES are more likely to have lower levels of PA compared with those who have high SES [8–10]. Low SES persons with diabetes consistently report worse health outcomes, including uncontrolled glycated hemoglobin (HbA1C) [11], and higher rates of diabetic complications and mortality than high SES persons with diabetes [12]. A lack of knowledge and limited availability of health resources for low SES persons with diabetes have contributed to this health disparity. Existing literature has documented that, although persons with diabetes in low SES understand the benefits of PA, they reported a lack

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of knowledge regarding types or degrees of PA required to obtain benefits from PA [13, 14].

One possible way to improve PA levels in low SES persons with diabetes is by providing relevant information through media that can be easily accessed and utilized. Persons with diabetes use media such as magazines, the Internet, and television to obtain disease-specific and PA-related information [15]. Media use for health information is associated with increased PA levels and those who have used the increased number of media for health information are more likely to have higher levels of PA [16]. Considering the benefits of accessible health information on PA, media can be used as an important channel to improve PA levels in persons with diabetes.

However, there is a lack of knowledge regarding which media is effective in providing health information that further increases levels of PA, particularly for low SES persons with diabetes. Existing studies have primarily focused on health information seeking behaviors [15, 17] and primary sources of health information [16] in persons with diabetes. For example, Plotnikoff et al. [16] demonstrated that television and magazines are primary sources of health information. However, they did not examine whether the use of television or magazines are related to the PA levels of persons with diabetes. Further, since previous research did not target low SES persons with diabetes, it is not clear if the findings from previous research would apply to this population. To reduce health disparities in PA levels in the diabetic population, it is critical to identify which media is relevant for delivering PA-related information to low SES persons with diabetes.

To address the gaps in knowledge, the overall purpose of this study was to determine the appropriate media for providing PA-related information to low SES persons with diabetes compared with high SES persons with diabetes. The specific aims were (i) to examine the relationships of media use for health information and SES (i.e. low and high) with PA and (ii) to examine the interaction effect of SES on the relationship between media use for health information and PA. In addition, since age is an essential factor that impacts media use for health information [18], we further examined whether the above relationships differ by age.

Materials and methods

Design

A secondary data analysis was performed using the data from the Multimedia Audience Research Systems (MARS) over the counter (OTC)/direct to consumer (DTC) Pharmaceutical Study of 2013 (MARS 2013 hereafter) by Kantar Media. As a cross-sectional survey, MARS 2013 aimed to estimate the incidences of various OTC/DTC usage segments among adults in the USA and provide detailed information regarding demographics and media behavior on various OTC/DTC usage segments. Since MARS 2013 data are publicly available, this analysis was exempted by the Institutional Review Board.

Participants

Data from the MARS 2013 consist of a national sample and a list-enhanced oversample. The national sample of 26 800 individuals was obtained through a systematic random sampling procedure from the KBM's AmeriLink database of 242 million consumers living in the USA. The list-enhanced oversample was also included in the survey in order to collect more information about people with various health conditions; The MARS 2013 selected 23 866 people who were living in the USA and had family members who had suffered from diseases such as diabetes, cancer, or heart failure within the past 24 months from the ICOM TargetSource's database and Experian database of over 5 million consumers. As a result, a total of 19 420 adults participated in the MARS 2013. The data were collected from January 2013 to April 2013. Participants completed mailed questionnaires asking about their patterns of OTC/DTC pharmaceutical consumption and other related information, such as media use for health information, health conditions and health-related attitudes. Among the respondents of MARS 2013, individuals who self-

reported that they currently had diabetes, which had been professionally diagnosed, and belonged to either low or high SES group were included in this study. Individuals who belonged to a medium SES group were excluded from this study since this study aimed to determine appropriate forms of media to provide PA-related information particularly to low SES persons with diabetes compared with high SES persons with diabetes.

Measures

Socioeconomic status

Each participant's SES was determined by a combination of measuring income and educational background. To more accurately calculate income level, each participant's annual household income, as well as one's family size (i.e. the number of adult members and related children under 18), were used. First, participants whose annual household incomes fell in the lower 33% (i.e. <$30 000) in the sample, which is comparable to the definition of low income for a single person household as of 2014 [19], were defined as a low-income group. In contrast, individuals within the upper 33% (i.e. $75 000 and above) were considered a high-income group, which is comparable to the definition of high income for a single person household [19]. In addition, participants whose annual household income did not exceed the poverty threshold, based on the US Department of Health and Human Services poverty guidelines of 2013 [20], were also considered a low-income group. For example, if a participant's annual household income was $31 000 and his or her family size was six, the participant belonged to the low-income group because his or her household income did not exceed the poverty threshold for a six-person family, which was set at $31 590. Similarly, participants with household income of $40 000–49 000 were divided into two groups based on their family size: participants with a family size greater than seven were categorized as the low-income group, whereas those with a family size equal to or smaller than 7 members were assigned to the high-income group. Second, to determine their educational background, participants were asked to provide the highest educational degree that they had completed. Like the income groups were categorized, participants in the lower 33% of education level (i.e. completed high school or less) were considered a low education group, while people in the upper 33% (i.e. college graduate and above) were considered a high education group. Upon combining the income levels and educational backgrounds of each participant, those belonging to both the low income and the low education groups were identified as the low SES group, and those in the high income and the high education groups were identified as the high SES group. As a result, a total of 770 persons with diabetes who belonged to either the low ($n = 564$, 73.2%) or high ($n = 206$, 26.8%) SES group were selected for analysis (Fig. 1). Participants who did not belong to either the low or high SES group were excluded from further analysis to maximize the differences between the low and high SES groups.

Media use for health information

Participants in MARS 2013 were asked to provide information about their media use for health information, including magazines, radio, television and the Internet. Magazines and television, the primary media types which persons with diabetes use to obtain health information [16], and the Internet, the primary source of PA-related information in the general population [21], were selected for this study. 'Magazine use' was measured by an 8-point scale (0–7) which counted the number of health-related magazines (i.e. *Arthritis Today*, *Diabetes Forecast*, *Health, Prevention*, *Men's Health*, *Psychology Today*, and *Women's Health*) that participants were subscribed to in the previous six months. Considering that a 1-year magazine subscription is most common, this time referent is indicative of recent magazine readership. 'Television use' was measured by asking participants which types of health-related television programs they had watched in the previous seven days, as most television programs air based on a weekly schedule. The types of health-related television programs were health-specific television shows such as

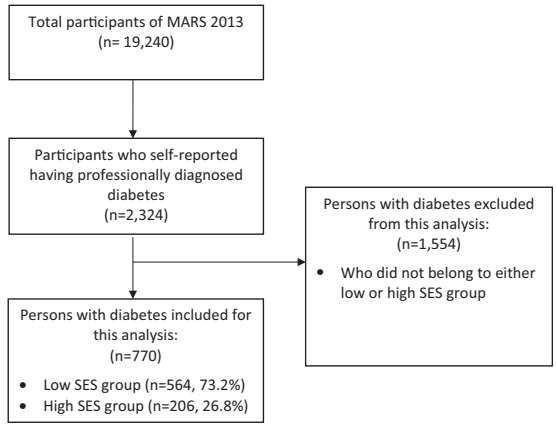

Fig. 1. Diagram of sampling.

dLife, The Doctors, and The Dr Oz Show, and self-improvement television shows such as The Biggest Loser and DietTribe. 'Television use' was scored from 0 (no television programs watched) to 2 (both types of television programs watched). 'Internet use' was measured by a 25-point scale (0–24) asking participants how many websites they had used to obtain or search for health information over the previous 30 days among a list of 24 websites. This time referent is long enough to assess the use of 24 websites, which include major search engines such as Google, Bing and Yahoo, health-specific websites such as Mayo Clinic, WebMD and health.com, and other popular sites such as Wikipedia, Facebook and YouTube. The questions were developed by Kantar Media for MARS 2013.

Physical activity

The primary outcome variable, PA, was measured by an 8-point scale (0–7) asking participants how many days they exercised or engaged in strenuous PA for 30 min or more at a time in the previous 7 days. This question was also developed by Kantar Media for MARS 2013.

Covariates

Demographic information such as age, gender and standard body mass index (BMI) were controlled for the analysis, as these are known to be related to PA [8]. Since this study examined the relationships by age, age was dichotomized into younger (18–54) and older (55 and above) groups. BMI was categorized as 1 = Underweight (BMI < 18.5); 2 = Normal weight (BMI 18.5–24.9); 3 = Overweight (BMI 25–29.9); and 4 = Obese (BMI > 30).

Analytic procedure

Data were analyzed using the Statistical Package for Social Sciences® version 22.0 (SPSS Inc. Chicago, IL, USA). Descriptive statistics such as means and standard deviations were used to describe demographics, media use for health information, and PA of participants. This study conducted three ordinary least square (OLS) regression analyses, and listwise deletion was used to deal with missing data. Because of positive skewness, 'magazine use' and 'Internet use' were log-transformed for analyses. For aim 1, to examine the relationships of media use for health information and SES with PA, the first model focused on the overall relationships of the predictors, SES and media use for health information, with the primary outcome variable, PA. In the first OLS regression model, demographic variables such as age, gender, and race were initially entered in the first block along with BMI. The main predictor, SES, was entered in the next block, followed by the media use for health information variables in the third block. For aim 2, to examine the interaction effect of SES on the

relationship between media use for health information and PA, two-way interaction terms between SES and the three media use for health information variables (i.e. SES × magazine use, SES × Internet use, and SES × television use) were entered in the fourth block.

This study further investigated how the relationships among SES, media use for health information, and PA differ by age. Participants were categorized into two groups, younger (age 18–54) and older (age 55 and above), and two separate OLS regression analyses were conducted. Similar to the first model, gender, race, and BMI were entered in the first block of OLS regression models. SES was entered in the second block, followed by the media use for health information variables in the third block. Three two-way interaction terms between SES and the media use for health information variables (i.e. SES × magazine use, SES × Internet use and SES × television use) were entered in the last block. The statistical significance of each model was validated by an F-test for analysis of variance at a 95% confidence level.

Results

Participants' characteristics

The majority of 770 participants were women (n = 534, 69.4%), older than 55 (n = 561, 61.6%), white (n = 648, 84.2%), had relatively high BMI (mean = 3.42, SD = 0.71), and belonged to the low SES group (n = 564, 73.2%) (Table I). The mean of magazine use in the previous 6 months was 2.1 (SD = 0.59), the mean of Internet use in the past 30 days was .59 (SD = 1.20), and the mean of television use in the previous 7 days was 1.9 (SD = 0.47). The mean number of days that participants exercised or engaged in strenuous physical labor for 30 min or more was 2.26 (SD = 2.03) out of the previous seven days.

Relationships of SES and media use for health information with PA

The relationships between SES and PA and the relationship between media use for health information and PA were examined. After controlling for age, gender, race, and BMI, SES was positively related to PA ($\beta = 0.15$, $P < 0.01$), suggesting that participants in the high SES group were more frequently engaged in PA than those in the low SES group. In terms of the media use for health information, magazine use was positively associated with PA ($\beta = 0.11$, $P < 0.05$). Television use also had a significant and positive association with PA ($\beta = 0.13$, $P < 0.01$) (Table II).

Interactions of SES on the relationship between media use for health information and PA

In particular, an interaction effect between SES and television use was found to be significant ($\beta = -0.09$, $P < 0.05$). As Fig. 2 shows, the gap in PA between the low and high SES groups increased among participants who watched more health-related television programs.

Relationships of SES and media use for health information with PA by age groups

This study further investigated how the relationships of SES and media use for health information on PA differ by age groups. The results revealed that SES is positively related to PA in both older ($\beta = 0.11$, $P < 0.05$) and younger ($\beta = 0.24$, $P < 0.01$) groups. However, the relationships between media use for health information and PA were found to be significant only among the older group. Magazine use was positively associated with PA ($\beta = 0.11$, $P < 0.01$) and television use had a positive relationship with PA ($\beta = 0.10$, $P < 0.05$) (Table III).

Interactions of SES on the relationship between media use for health information and PA by age groups

Notably, a significant interaction was found between SES and Internet use on PA ($\beta = 0.15$, $P < 0.05$). As shown in Fig. 3, among the older participants, the relationship between Internet use and PA was positive among participants in the high SES group, whereas the relationship followed a negative trend among participants in the low SES group.

Table I. Descriptive information of participants ($n = 770$)

	n	%
Age		
18–55	209	27.1
55+	561	72.9
Gender		
Female	236	30.6
Male	534	69.4
Race		
White	648	84.2
Others	122	15.8
Education		
Less than high school	145	18.8
High school graduate	419	54.4
College graduate	97	12.6
Post-graduate study or degree	109	14.2
Household income		
Less than $20 000	311	40.4
$20 000 to $29 999	157	20.4
$30 000 to $39 999	10	1.3
$40 000 to $49 999	86	11.2
$75 000 to $99 999	60	7.8
$100 000 to $124 999	43	5.6
$125 000 to $149 999	27	3.5
$150 000 to $249 999	46	6.0
$250 000 or more	30	3.9

Discussion

Although there are various media that deliver health information across SES, there is a lack of knowledge regarding which media is appropriate for communicating health information with low SES persons with diabetes. This study aimed to determine the appropriate media for providing PA-related information to low SES persons with diabetes compared with high SES persons with diabetes. Consumption of health information on television was positively related to PA levels in low SES persons with diabetes. In contrast, the use of the Internet to access health information was negatively related to PA levels in low SES persons with diabetes over the age of 55.

Previous studies which examined relationships between media use and health behaviors such as PA in the general population have documented that television use is unrelated to health behaviors [22, 23]. Rather, when individuals use the Internet and/or print media including newspapers and magazines for health information, they were more likely to have higher levels of health behaviors [24]. These findings have been explained in terms of health motivation and health consciousness. Since television is a passive medium where individuals can obtain health information without engaging in an active search process, individuals who are less motivated and/or health-oriented will seek health information via television and are less likely to engage in health behaviors [21]. On the other hand, the Internet is a medium, which requires an active searching and navigation process to obtain desired information. Individuals who are health-motivated and/or oriented tend to utilize the Internet to obtain health information, and are more likely to engage in health behaviors [22].

However, this study found that different relationships exist among low SES persons with diabetes between media use and PA. Inconsistent with previous findings [21, 22], this study documented that television use was related to higher levels of PA, indicating that television can be a useful resource for improving PA levels among low SES persons with diabetes. In addition, Internet use was related to lower levels of PA in older, low SES persons with diabetes. This finding indicates that, although the Internet provides volumes of health information, the Internet may not be useful for increasing PA levels in older, low SES persons with diabetes.

Limited health literacy among low SES persons with diabetes may explain the findings. They tend to have a lower level of health literacy than high SES persons with diabetes [25, 26]. Limited health literacy makes individuals less able to understand health information provided by media [14, 25–27], and further reduce their motivation to engage in PA [28]. In spite of copious information from the Internet, individuals with low SES have challenges in searching for their desired health information, as well as understanding that health information [14, 25–27, 29]. However, since television provides audiovisual content with lay-term explanations and demonstrations, television has been chosen as the form of

Table II. *Relationships of SES and media use with PA*

	B	SE[a]	β
Block 1: Control variables			
Age	–0.060	0.029	–0.075*
Gender (Male =1, Female =2)	–0.076	0.159	–0.017
Race (Caucasian =1)	–0.223	0.197	–0.040
Standard BMI[b]	–0.312	0.100	–0.110**
ΔR^2 (F)	0.025 (4.825)***		
Block 2: Predictor 1			
SES[c] (Low = 1, High = 2)	0.697	0.225	0.153**
ΔR^2 (F)	0.023 (7.637)***		
Block 3: Predictor 2			
Magazine use	0.693	0.274	0.110*
Television use	0.530	0.169	0.125**
Internet use	−0.090	0.187	−0.023
ΔR^2 (F)	0.025 (6.977)***		
Block 2: Interactions			
SES × Magazine use	–0.046	0.482	–0.004
SES × Television use	–0.951	0.418	–0.092*
SES × Internet use	0.295	0.295	0.059
ΔR^2 (F)	0.025 (5.621)***		
R^2	0.075		

[a]Standard error.
[b]Body mass index.
[c]Socioeconomic status.
$^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$.

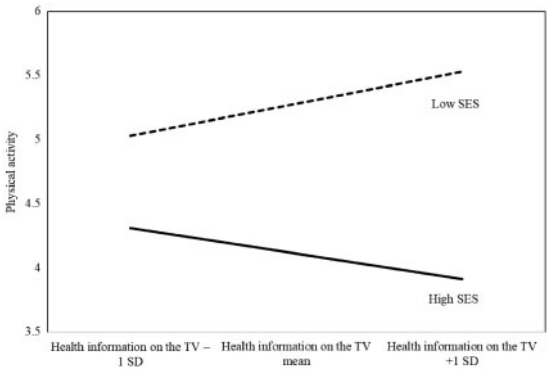

Fig. 2. Interaction of SES and television use on PA.

media preferred by individuals with limited health literacy to obtain health information [30].

In addition to limited health literacy, a knowledge gap exists between individuals with high and low SES that is associated with the unequal benefits from Internet use [31]. The 'knowledge gap hypothesis' [32] explains:

'As infusion of media information into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments' (p.159-160).

The hypothesis indicates that individuals with higher SES are more likely to obtain health information from the Internet because of their high media competence, which leads to systematic Internet use. On the other hand, those with lower SES are less likely to acquire health information because of their low media competence, resulting in less profitable Internet use [33]. Lower media competence in low SES persons with diabetes may keep them from acquiring applicable information for PA. Considering the limited literacy and media competence of older, low SES persons with diabetes, the

Table III. *Relationships of SES and media use with PA by age groups*

	The older (n = 561)			The younger (n = 209)		
	B	SE[a]	β	B	SE	β
Block 1: Control variables						
Gender (Male =1, Female =2)	–0.209	0.186	–0.048	0.291	0.316	0.065
Race (Caucasian =1)	–0.466	0.240	–0.082	0.157	0.353	0.031
Standard BMI[b]	–0.291	0.115	–0.104*	–0.407	0.210	–0.138
ΔR^2 (F)	0.026 (40.963)**			0.029 (20.061)		
Block 2: Predictor 1						
SES[c] (Low = 1, High = 2)	0.506	0.254	0.114*	1.166	0.501	0.239*
ΔR^2 (F)	0.025 (70.517) ***			0.014 (20.299)		
Block 3: Predictor 2						
Magazine use	0.654	0.307	.109*	.937	.618	.128
Television use	0.455	0.215	.099*	.545	.284	.148
Internet use	–0.264	0.236	–.066	.200	.312	.057
ΔR^2 (F)	0.016 (50.727) ***			0.034 (20.389) *		
Block 2: Interactions						
SES × Magazine use	–0.072	0.536	–0.007	–0.132	10.110	–0.011
SES × Television use	–0.673	0.495	–0.065	–10.302	0.819	–0.124
SES × Internet use	0.771	0.356	0.150*	–0.669	0.564	–0.142
ΔR^2 (F)	0.010 (4.643)***			0.023 (2.196)*		
R^2	0.078			0.054		

[a]Standard error.
[b]Body mass index.
[c]Socioeconomic status.
$^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$.

Internet may not be appropriate in providing actionable health information [17].

Although Internet use was negatively related to PA levels in older, low SES persons with diabetes, the Internet has advantages of providing tailored information under an interactive learning environment. Further efforts should be given to explore challenges of the aging diabetic population with low SES in obtaining health information from the Internet. Researchers also need to investigate strategies regarding how to assist them to have effective online navigation skills. Findings from such studies will inform future online interventions targeting the aging diabetic population with low SES.

Although gender is another factor that influences media use for health information, gender was not significantly related to levels of PA in this study. Women are more likely to use media as a source of health information than men including reading newspapers or magazines, listening to radio, watching television programs [34] and navigating the Internet [35, 36]. Women are also more likely than men to seek health information specific to their illnesses and/or symptoms [35]. Even though women use media for illness- or symptom-specific health information more frequently than men, this study did not find a significant difference in PA between women and men. To enhance the understanding of how gender difference impacts PA, a comprehensive approach is necessary to investigate the relationships between gender difference, media use for health information, and levels of PA.

Implication for practice and research

Considering that this study used data from a randomly selected national sample and list-enhanced oversample, the findings of this study have the potential to be generalized to the adult diabetic

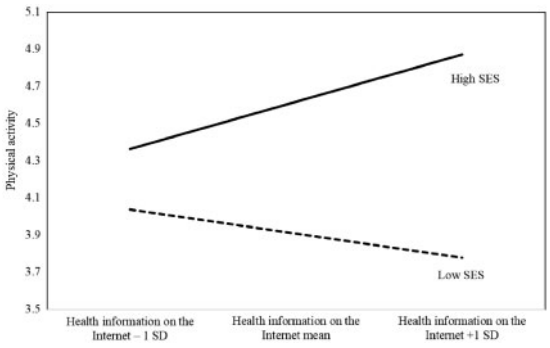

Fig. 3. Interaction of SES and Internet use on PA in the older group (age over 55).

population in the USA. As an overall effort to decrease health disparities, this study suggests the need for developing relevant and effective strategies for low SES persons with diabetes to increase their PA levels. Healthcare providers should encourage PA by educating them how to properly use television to acquire PA-related information, such as how to select informative television programs. PA-related information should be delivered using appropriate media. Future PA campaigns targeting low SES persons with diabetes to increase PA levels should consider the use of television programs to deliver PA-related information. This study also suggests that further investigation regarding the Internet use in older, low SES persons with diabetes is needed. Given that the Internet can provide interactive and tailored learning environments, future studies should investigate challenges that older, low SES persons with diabetes have utilizing the Internet for health information. Further efforts should be given to identify strategies to improve their media competence. Findings from such studies will inform future online PA intervention studies targeting the aging diabetic population with low SES.

Limitation

Although the findings were obtained using data from a large nationwide survey, there are a few limitations. Since this study extracted data from MARS 2013, the predictors and outcome variable for analyses were limited to data as collected. The participants self-reported their medically diagnosed diabetes, but their diagnoses were not confirmed using participants' medical records. Next, the questionnaires used were developed for MARS 2013 and have not been validated. Specifically, the primary outcome, PA, was not assessed using a validated measure, and this limitation should be considered in understanding the findings from this study. Further effort is necessary to confirm the relationships between media use and PA by SES utilizing validated measures of PA such as accelerometry-based activity monitor in addition to self-report questionnaires. Since the data were obtained from a cross-sectional study, causality between predictors and the outcome variable cannot be established. Further longitudinal studies should examine causal relationships. In addition, although the large sample size in this study has several advantages for conducting multivariate analyses, it placed limitations on the interpretation of the findings. For example, the significant interaction effect of television use and SES became insignificant when testing the models separately for each age group, suggesting potential Type I error. Further investigations with a more robust analytic design need to be conducted to confirm the impacts of media use for health information and SES on PA among persons with diabetes.

Conclusion

In summary, this study is significant for identifying the SES difference in the relationships between media use for health information and PA among persons with diabetes. Low SES persons with diabetes had a lower level of PA than high SES persons with diabetes. The relationships of media use for health information with PA levels varied by SES; while television use for obtaining health information was associated with increased PA levels, the use of the Internet for obtaining health information was associated with decreased PA levels among older, low SES persons with diabetes. The findings of this study suggest that it is critical to choose appropriate

media for low SES persons with diabetes in order to provide PA-related information.

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Conflict of interest statement

None declared.

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