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Internet use and depression among older adults

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ABSTRACT

The findings regarding the impact of Internet use on well-being are mixed and studies are often criticized due to small samples and lack of consistency in measurement. Fewer studies have examined this issue among older adults. The purpose of this study is to examine the relationship between Internet use and depression among retired Americans age 50 years or older. Using data from the Health and Retirement Survey, the study estimates the relationship between Internet use and depression through combined use of regression and propensity score methodologies. All empirical methods indicate a positive contribution of Internet use to mental well-being of retired older adults ($\geqslant$50 years), reducing depression categorization by approximately 20–28%.

1. Introduction

Social isolation, decreased social contact, and lack of emotional support are risk factors for depression in older adults (Bradley & Poppen, 2003; Eastman & Iyer, 2004; Wright, 2000). Nearly 8% of older adults report current depression, and nearly 20% report a lifetime diagnosis of depression (National Institute of Mental Health, 2009, p. 6), some type of mental disorder (US Department of Health and Human Services, 1999), or clinically relevant depressive symptoms (Federal Interagency Forum on Aging-Related Statistics, 2004).

Using the Internet for communication may help reduce social isolation, loneliness, and depression, as well as enhance social support among older adults (Blit-Cohen & Litwin, 2004; Cotten, 2009; McMellon & Schiffman, 2002; White et al., 1999; Xie, 2007). Yet, some researchers suggest that Internet usage may have negative effects on people's mental well-being (e.g., Kraut et al., 1998; Nie & Erbring, 2000). Our study attempts to more fully examine the relationship between Internet use and depression by applying regression and propensity score methods to a large sample of non-working retired older Americans.

1.1. Relationship between Internet use and depression among older adults

Prior research on Internet usage among older adults indicates technology use results in increased social support, social contact, social connectedness, and greater satisfaction with that contact (Bradley & Poppen, 2003; Mellor, Firth, & Moore, 2008; Trocchia & Janda, 2000). For older adults, mobility and activity limitations may increase the importance of the Internet for interpersonal communication, maintaining family bonds (especially across vast distances), and expanding social networks (Climo, 2001; Cotten, 2009; McMellon & Schiffman, 2000; Nahm & Resnick, 2001; O'Hara, 2004). Ito, Adler, Linde, Mynatt, and O'Day (1999) note that older people who are physically isolated and have lower social support may benefit from social uses of the Internet. And, White et al. (2002, p. 220) suggest that older adults may "develop new social activity to replace activities that have become more difficult for them to perform and to strengthen existing social ties with family and friends through the Internet." Increased contact with social network ties helps individuals feel close to others, which impacts their sense of mattering and mental health (Cotten, 2008, 2009).

Unfortunately, many prior studies have been based on small samples, which limit the statistical sophistication and the robustness of the findings: Bradley and Poppen (2003), 20 observations; Mellor et al. (2008), 12 observations; Eastman and Iyer (2004), 171 respondents; Sum, Mathews, Hughes, and Campbell (2008), 222 respondents. Those who call into question altogether the positive effects of technology use on older adults (Dickinson & Gregor, 2006; Huang, 2010) indicate that the small sample sizes and range of measures used in many prior studies may contribute to problematic results.

1.2. Research objectives

We examine whether Internet use reduces the probability of a depression categorization among older adults by applying regression and propensity score methods (Imbens & Wooldridge, 2009).

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2. Methods

2.1. Sample

The data used are from the 2006 Health and Retirement Study (HRS). We exclude observations with missing data and participants who are not yet retired or are working, live in a nursing home, or are ages 49 and younger. The final sample is 7839 observations.

2.2. Measures

2.2.1. Depressive symptoms

Depressive symptomology is based on an eight-item version of the Center for Epidemiologic Studies Depression scale (the CES-D) (McDowell & Newell, 1996; Radloff, 1977), a commonly used measure of depression (Eaton, Muntaner, Smith, Tien, & Ybarra, 2004; Radloff & Teri, 1986; Siegel, Bradley, Gallo, & Kasl, 2003, 2004). The CES-D scale is converted to a dichotomous variable with depression scores $\geqslant 4$ coded as 1 (Blustein, Chan, & Guanais, 2004; Mojtabai & Olfson, 2004; Nygaard, Turvey, Burns, Crischilles, & Wallace, 2003).

2.2.2. Internet use

Internet use is based on the question: "Do you regularly use the World Wide Web, or the Internet, for sending and receiving e-mail or for any other purpose…?" (1 = yes, 0 = no).

2.2.3. Control variables

Motivated by prior research (Dragano et al., 2008), covariates include: age (in years) and its square; male (=1); married (=1); years of education; and presence of a debilitating physical health condition (=1). We include dummy variables for the months November–January, as responses in these months may reflect Seasonal Affective Disorder (Lurie, Gawinski, Peirce, & Rousseau, 2006). Other determinants of Internet access and use (Cotten, 2010; Hale, Cotten, Drentea, & Goldner, 2010; Stern, Adams, & Elasser, 2009; Whitacre, 2007) are used in the propensity score regression: dummy variables equal to 1 if the respondent is poor, African–American, Hispanic, has four or more persons in the home, or four or more living family members; nine Census region dummies; annual household income and its square; and an interaction of age and the physical disability dummy variable.

There are some differences in the covariate values between those that use and do not use the Internet (see Table 1). Without sufficient covariate overlap between the treated and untreated groups, the estimated treatment effects may be poorly estimated. Our empirical strategy attempts to remedy this problem.

2.3. Empirical strategy

To address selection bias and heterogeneity in the covariate distributions (Imbens & Wooldridge, 2009) (results available from authors), we use regression analysis and propensity score methods (PSMs) in a two-stage process. First, we estimate the propensity score, $p(X)$, by Logit regression. Second, we stratify the sample in quintiles by $p(X)$ and estimate the effect of Internet use on depression by regression (Imbens & Wooldridge, 2009). We briefly compare the results to those produced by other estimation approaches.

2.3.1. The propensity score

The propensity score is the predicted probability of receiving the treatment (Internet use), estimated by Logit regression. Twenty-one of 25 covariates are statistically significant at the 10% level. The Pseudo-R^2 is .198. The null hypothesis of the Hosmer–Lemeshow Test (i.e., "the model is correctly specified") is not rejected; the Receiver Operator Characteristic (ROC) is .793, indicating excellent predictive power (Baser, 2006; Hosmer & Lemeshow, 2000, p. 162). Following recommended procedure (Imbens & Wooldridge, 2009, pp. 43–44), we trim the sample for common support (*full sample* has 7714 observations, a loss of 125 observations).

Table 1
Descriptive statistics (n = 7839).

Covariates	Full sample	Internet use		Depressive symptoms	
		Yes	No	Yes	No
Age	73.55	70.68	74.75	72.78	73.70
Age^2	5488	5488	5393	5488	5506
Married	0.570	0.710	0.512	0.385	0.607
Educ. years	12.26	13.83	11.60	11.19	12.47
Male	0.434	0.467	0.420	0.335	0.453
Poor health	0.100	0.054	0.119	0.288	0.063
November	0.024	0.025	0.023	0.036	0.022
December	0.012	0.012	0.012	0.010	0.012
January	0.008	0.010	0.006	0.018	0.006
Income	43,216	43,216	30,852	43,216	45,652
Income^2	5.4 + 09	5.4 + 09	2.9 + 09	5.4E + 09	5.9 + 09
Poverty	0.094	0.094	0.170	0.094	0.080
Many in home	0.063	0.063	0.079	0.063	0.059
Afr. American	0.139	0.139	0.186	0.139	0.130
Hispanic	0.061	0.061	0.090	0.061	0.055
Family members	0.951	0.951	0.969	0.951	0.947
Age × Income	3.1 + 06	3.1 + 06	2.2 + 06	3.1 + 06	3.3 + 06
Depression	0.164	0.097	0.189	1.000	0.000
Internet use	0.295	1.000	0.000	0.178	0.318
n	7839	2314	5525	1290	6549

3. Results

Following Imbens and Wooldridge (2009, p. 33), we estimate the effect of Internet use on depression by subclassification with regression, dividing the full sample into quintiles based on the propensity score, $p(X)$. This approach resolves the covariate overlap problem noted above; the normalized differences are below 0.25 for all covariates in each quintile (Imbens & Wooldridge, 2009, p. 24). Given dummy variables for each of our quintiles, g_i (i = 1, 2,…,5), we estimate the effect of Internet use (u) on depression (y) using the Logit regression,

$$y_i = \sum_{j=1}^{5} \alpha_j g_j + \sum_{i=1}^{5} \lambda_j g_j u_i + X\beta + \upsilon_i, \quad (1)$$

where X is a matrix of covariates and β their coefficients. The null hypothesis is simply a joint test on the λ_j coefficients (Imbens & Wooldridge, 2009, p. 41), and the average effect of Internet use on depression is one-fifth of the sum of the λ_j coefficients.

From the estimates of Eq. (1), a computation of the treatment effect is −.435 with $t = -3.96$, $p < .010$ (see Table 2). Using the estimates to predict the probability of a depression categorization, the probability of depression is about 28% less among Internet users compared to Internet non-users. Table 2, last column, shows the estimated effect is barely affected if we exclude the $X\beta$ from Eq. (1), with an identical 28% reduction in depression categorization from Internet use, though the explanatory power declines.

3.1. Alternate estimators

The treatment effect was estimated using a wide range of alternate techniques, including radius matching and kernel matching (Caliendo, 2006, p. 52). The results were comparable (about −22% on a depression categorization). Logit on the full sample, and a trimmed sample where $.10 \leqslant p(X) \leqslant 0.90$ (Crump, Hotz, Im-

Table 2
Summary of regression results.

	Subclassification Regression	Subclassification Block
Treatment		
Internet use	−0.435**	−0.400**
	(0.078)	(0.010)
Covariates		
Age	−0.230**	–
	(0.047)	
Age^2	0.001**	–
	(0.0003)	
Married	−0.682**	–
	(0.078)	
Educ. years	−0.070**	–
	(0.018)	
Health	1.538**	–
	(0.091)	
Male	−0.298**	–
	(0.074)	
November	0.621**	–
	(0.188)	
December	−0.392	–
	(0.286)	
January	1.100**	–
	(0.356)	
Constant	–	–
N	7714	7714
Pseudo-R^2	0.12	0.04
H–L test (Prob)	0.42	–
ROC	0.74	0.64

** $p < .010$.

bens, & Mitnik, 2009), likewise rendered similar results (about −24% on depression categorization). If depression influences Internet use, so that use and mental well-being are determined jointly in a simultaneous system, instrumental variables are an appropriate estimation method. Using $p(X)$ as an instrumental variable (Baser, 2006), we find that Internet use reduces a depression outcome by about 26%. Our findings are robust to estimation strategy. Full details are available from the authors.

4. Discussion

Internet use reduces the probability of a depression categorization for older adults by about 20–28%. The effects of Internet use on depression are large and positive, resolving, at least to some extent, the lack of evidence supporting the Internet's impact on depression among older adults (Dickinson & Gregor, 2006).

We note a few limitations. The sample is limited to non-working retired Americans. Impacts may differ between working and non-working older adults. We cannot distinguish between the use of broadband and dial-up Internet services (Davison & Cotten, 2009; Hale et al., 2010). We estimate the effect using cross sectional data. We have a very basic measure of Internet usage (yes/no). More nuanced measures might reveal specific ways through which Internet usage affects well-being. We hope this research encourages further examination of the interrelationships among Internet use and depression.

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