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Factors related to moderate exercise during COVID-19 for overweight and obese individuals: A secondary analysis of HINTS data

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ABSTRACT

Objective: COVID-19 has exacerbated pre-existing rates of overweight and obesity in the United States. mHealth technologies are gaining in popularity for its potential to reduce obesity, if facilitated by patient-centered communication. This study explores predictors of overweight and obese individuals' exercise levels during COVID-19.
Methods: 2191 respondents who visited a doctor in the past year and self-reported being overweight were selected from the 2020 Health Information National Trends Survey (HINTS). Respondents reported their physical activity, beliefs about obesity, health tracking behaviors, and communication with providers during the pandemic. Structural equation modeling was used to explore connections among the variables.
Results: Patient-provider (e-)communication was significantly associated with changes in people's obesity-related beliefs and mHealth tracking usage, predicting moderate exercise during the pandemic.
Conclusion: The findings illustrate the need for patient-centered communication encounters to include discussions on mHealth technologies and accessible methods of engaging in physical activity.
Innovation: This study examined secondary data provided by overweight and obese individuals from the early days of the COVID-19 pandemic; this population may benefit from targeted health interventions using mHealth technologies. Our findings suggest that healthcare providers should engage patients through mHealth technology and seek to improve digital health literacy to progress physical activity nationwide.

1. Introduction

The United States population is becoming increasingly overweight, with approximately 74% of adults over 20 years of age being overweight or obese and 43% being obese [1]. Obesity is associated with many health issues, including early death, cardiovascular issues, type 2 diabetes, and cancer [2]. The COVID-19 pandemic exacerbated this health issue, however, with many Americans gaining weight since the pandemic [3] leading to the creation of the recently coined term “covibesity” [4]. While factors of the pandemic weight gain include hightened stress, work from home policies, and the closure of gyms leading to increased sedentary behavior [4,5], researchers highlighted the role of significantly decreased physical activity (PA) in 2020. For example, one longitudinal study found that body weight and body mass index (BMI) both increased about 4–5 months after the first lockdown [6]. Another study suggested that inactive and obese individuals reported poorer self-perception of health during the pandemic [7]. PA provides benefits beyond weight loss, including improved feeling, function, and sleep [8]. Prior to the COVID-19 pandemic, addressing the obesity epidemic was important; now, it is more vital than ever to investigate relationships that may lead to the creation of interventions with the goal of improving health across the nation [9].

Patient-centered communication (PCC) and related effects on PA is well-established [10,11]. Benefits of mHealth technology, or the use of technology for health-related purposes (e.g., using health apps and tracking devices such as Fitbit), are also promising as it enhances users' PA over time [12]. Research also showed that obesity-related causal beliefs are associated with some lifestyle behaviors [13]. Yet, much research does not account for COVID-19, which has drastically changed the world, particularly in the realm of communicating with one's healthcare team. This study therefore explores predictors of overweight and obese individuals' exercise levels during COVID-19. Specifically, we examine how perceptions of PCC, mHealth usage, and obesity-related beliefs may predict PA.

1.1. Social Cognitive Theory (SCT)

SCT suggests that an individuals' health behaviors are a function of personal and environmental characteristics [14]. In this study, environments facilitating overweight patients' PA may encompass their healthcare experiences and health-related technologies. That is, amidst the limited capacity

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of healthcare services during the pandemic [15], there is great potential for eHealth and mHealth technologies to mitigate obesity-related challenges by encouraging PA [16]. For personal factors, we expect that one's causal beliefs about obesity may be related to one's PA (Fig. 1) [13,18]. Thus, guided by SCT, we explore how perceptions of PCC, use of technology for health-related purposes and obesity-related beliefs predicted overweight and obese people's exercise levels during COVID-19. Since communicative experiences may be “the best predictor of future behaviors” [19], we specifically highlight the role of PCC, regarding how it relates to one's obesity beliefs and technology-assisted weight management.

1.2. PCC

PCC involves responding to emotions, exchanging information, making decisions, fostering healthy relationships, enabling patient self-management, and managing uncertainty, all with the goal of improving health outcomes [20]. Many people struggle with maintaining their weight loss over time [21,22]. It is important for healthcare providers to use PCC in their encounters with overweight and obese patients, as these interactions allow patients to ask questions, participate in shared decision-making, and engage in practices for weight management. Research showed that strong patient-provider relationships may improve weight-loss adherence, and that providers' support may help patients maintain motivation over time [21]. While PCC may be especially important for people who are overweight or obese, it is also something that should be used for all, regardless of weight status. For example, people who are not overweight still should adopt healthy lifestyles like regular moderate-intensity PA and a nutritious diet [23]. Research also showed PCC mediated the impact of media consumption on people's adoption of healthy lifestyles, leading to better engagement in healthy eating and PA [24]. Hence, our study hypothesizes:

H1: PCC is associated with enhanced PA for overweight individuals during COVID-19.

During the pandemic where face-to-face communication is more limited than before, one patients engagement strategy for weight-loss may be via electronic communication (e.g., email, direct message through patient portals) [25]. Recent research suggested that patients' adoption of e-communication with providers may be a product of positive PCC experiences [25]. Street's three-stage model for the development of interactive health communication applications suggested that such mediated patient-provider communication may be valuable for patient care and education, leading to enhanced health outcomes (e.g., weight loss) [26]. Although previous research drew no definite conclusion on whether or not eHealth intervention can effectively increase PA [27], the literature provided some evidence that such interventions significantly improved moderate-to-vigorous PA among working-age women [28]. More recently, one experimental study showed that patient expectations of patient-provider communication significantly predicted mHealth communication [29]. Thus, in our research, we hypothesize:

H2: Patients' use of e-communication, as a product of PCC experience, may enhance overweight individuals' PA during COVID-19.

In addition to directly influencing PA, experiences in the healthcare environment may also indirectly affect PA by encouraging related technology use and casual beliefs.

1.3. Health-related technology

Pre-pandemic, mobile health (mHealth) technologies (e.g., mobile phones, wearable activity trackers like Fitbit) were established as having the potential for patient-centered care, as they helped patients with chronic conditions self-manage symptoms [30,31]. This technology can also provide users access to expert advice and peer support for daily exercise [32,33]. Review research suggests that such technology increased and maintained users' PA over time [12]. Research documented how mHealth potentially reduced weight and obesity-related costs due to their inexpensive nature [22,34]. One systematic review found that interventions using mHealth technologies found weight, body mass index (BMI), waist circumference reductions, and favorable lifestyle behavior changes across most of the studies examined [35]. Another review found that over half of the studies included reported positive effects of interventions using mHealth technologies on several primary outcomes (e.g., weight loss) [36]. Therefore, mHealth technologies hold great promise and merit further research. When COVID-19 started, many health providers shifted appointment delivery from face-to-face to telehealth. Yet, little research exists on individuals' uses of mHealth technology during the COVID-19 pandemic. Our research contributes towards bridging that gap by exploring the following hypothesis:

H3: Uses of mHealth technology (e.g., tracking) lead to enhanced overweight individuals' PA during COVID-19.

The literature suggested providers usually encourage patients to use digital self-monitoring to manage chronic symptoms [37]. Research also documented positive association between patient-provider (e-)communication and uses of tracking devices [25].Therefore, we hypothesize:

H4: PCC experience and e-communication with providers may lead to overweight individuals' uses of mHealth technology (e.g., tracking) during COVID-19.

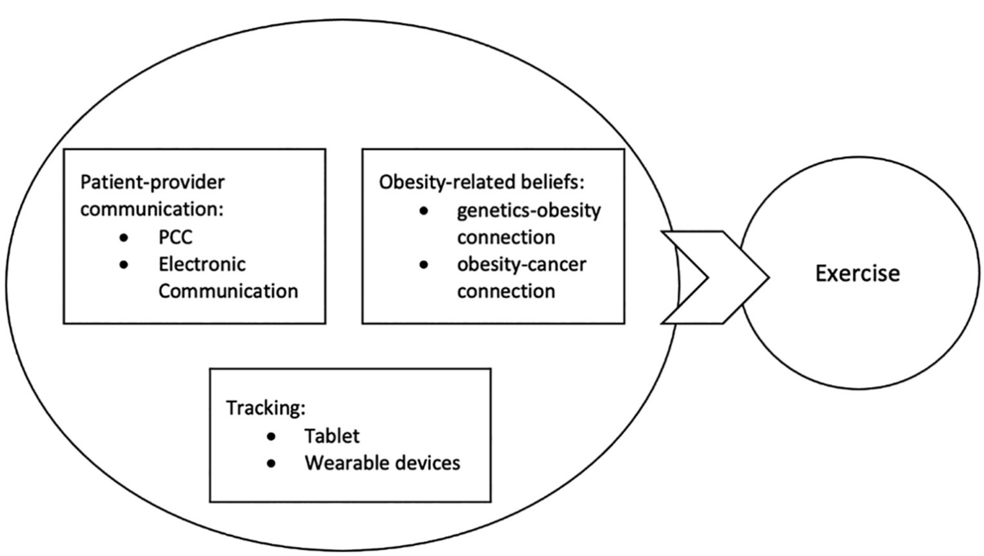

Fig. 1. Conceptual Model.

1.4. Obesity-related beliefs

Patients who have good communication experience with providers tend to increase their medical knowledge through effective information exchange [38,39]. In one study, providers' supportive communication explaining how genomics would cause obesity can help patients reduce weight-related stigma [40]. Though, this might generate countereffects as patients can stop crediting external factors (e.g., PA) for weight management. In this case, provider need to educate patients on the damage of obesity [41], further refining patients' self-management strategies (e.g., exercise) [39]. Thus, our project is important to further understanding in this area. Using questions from the HINTS data collected during the COVID-19 pandemic, this study explores how patient-provider communication is associated with two obesity-related perceptions (i.e., *how genetics affect obesity* and *how obesity may relate to cancer*), potentially predicting self-management behaviors (e.g., health tracking, moderate exercise) for obesity during a specific time period.

Based on the theory of planned behavior [19], communicative environments foster beliefs, anticipating human behavior. Previous research also suggested that obesity management behavior (e.g., PA) was associated with (1) believing that obesity is not inherited [13] and (2) maintaining a healthy body weight can prevent cancer (relapse) [42]. Therefore, we hypothesize:

H5: (E-)communication with providers may educate overweight individuals on two obesity-related perceptions (i.e., how genetics affect obesity and how obesity may relate to cancer), leading to increased obesity management (e.g., health tracking, PA).

2. Methods

2.1. Data and sampling

This study used nationally representative data from the Health Information National Trends Survey (HINTS5, Cycle4), which was administrated by the National Cancer Institute (NCI) from February 24 through June 15, 2020, with the focus on cancer care in the United States. The survey was conducted by mail, using address-based probability sampling. Each participant received a $2 prepaid incentive for participation. Overall, 3865 eligible questionnaires were collected (25.2%). To answer the research question, a total of 2191 respondents who went to a doctor in the past year and reported being overweight (having a Body Mass Index (BMI) over 25.0) [43] were selected as this study's sample.

2.2. Measures

Perceptions of PCC experiences were measured by the sum of seven dichotomized items. Participants were prompted to reflect on an interaction with a health care provider from within the last 12 months. Sample items of this category include “How often did your health care providers explain things in a way you could understand” and “How often did your health care providers spend enough time with you.” Originally, the seven items of this category were measured on a 4-point Likert scale, ranging from never (0) to always (3). To adjust the skewness of the answers, the highest point, always, was recoded as “1” and all the other answer points were recoded as “0” [44,45]. The Cronbach ∂ among all the seven items was 0.935, suggesting excellent scale reliability. The value of this variable ranged from 0 to 7 (M = 3.45, SD = 2.94), with “7” being the highest and “0” being the lowest levels of PCC.

E-communication with providers was the sum of three items [25]. The items asked if respondents messaged, emailed, and digitally shared health data with doctors. A sample item was, “In the past 12 months, have you used email or the internet to communicate with a doctor or the doctor's office?” All items were scored on a yes–no basis (0 = no, 1 = yes). After adding up the three items, the value of the outcome variable, electronic communication, ranges from 0 to 3 (M = 0.86, SD = 0.96). A higher value indicates having used more types of electronic communication with providers.

The *tracking of health-related data* was measured by adding up two dummy items [25], asking if respondents used a tablet or other electronic wearable devices to track health-related goals (e.g., smoking cessation, weight loss) (0 = no and 1 = yes). After summing the two items, the value of this variable ranges from 0 to 2 (M = 0.65, SD = 0.79).

Belief about the connection between genetics and obesity was measured by an item, “How much do you think genes that are inherited determine whether or not a person will develop obesity?” It was scored on a 4-point scale (1 = not at all, 4 = a lot) (M = 2.69, SD = 0.99).

Belief about the connection between obesity and cancer was measured by an item, “How much do you think being overweight or obese can influence whether or not a person will develop cancer?” It was scored on a 3-point scale (0 = not at all/don't know, 2 = a lot) (M = 0.98, SD = 0.8).

The outcome variable, *frequency of doing moderate exercise*, was measured by one item, asking how many days in a week did the respondents do any exercise of at least moderate intensity (e.g., brisk walking, bicycling at a regular pace, and swimming at a regular pace). The answer ranged from 0 (“0 days”) to 7 (“7 days”) (M = 2.55, SD = 2.24). [46]

Demographic background included *age*, *gender*, *education*, *physical health*, and *mental health*. Specifically, *age* was a numerical variable, representing participants' actual age at the time of the data collection. *Gender* was measured as a dichotomous item (1 = male, 2 = female). *Education* was measured by an ordinal variable with five levels of educational background, including “less than high school,” “high school degree,” “some college,” “bachelor's degree,” and “post-baccalaureate degree.” *Physical health* was assessed by an item, “In general, would you say your health is…” The answers were measured on a 4-point scale (0 = poor to 3 = excellent). *Mental health* was measured by the average of four items that include items, such as “Over the past 2 weeks, how often have you been bothered by little interest or pleasure in doing things?” Answers to the items were assessed on a 4-point scale (0 = nearly every day to 3 = not at all). The average value of the four items still ranged from 0 to 3, with higher numbers indicating better mental health. The Cronbach ∂ of the four mental health items was 0.881.

2.3. Analysis

STATA 16.1 was used for data analysis. Structural equation modeling was conducted to test the hypotheses. Exogenous variable was PCC, and endogenous variables were other study variables (excluding the demographic variables). All endogenous variables were regressed on the exogenous variable. Beliefs about the connection between genetics and obesity, as well as that between obesity and cancer were intercorrelated, as they are obesity-related beliefs. Obesity-related beliefs and tracking behaviors were regressed on e-communication. The outcome variable was regressed on the obesity-related beliefs, tracking behaviors, and e-communication. The model controlled for the demographic variables potentially related to this study's context [47,48]. Missing values were removed prior to our analysis. Maximum likelihood method was used to estimate path parameters.

To test the model's goodness-of-fit, we used cutoff indices suggested by Kline (2015). These indices included Chi-square value ($p > .05$), root mean square error of approximation (RMSEA <0.08), comparative fit index (CFI ≥ 0.90), and standardized root mean square residual (SRMR <0.08).

3. Results

3.1. Demographics

The mean age of the sampled population was 58.07 (SD = 15.72). Of the 2191 participants, 1152 were females (52.6%) and 892 were males (40.7%). About 147 participants (6.7%) did not identify their gender. For education background, most participants (N = 652, 29.8%) attended some college, 550 participants had bachelor's degree (25.1%), 406 were high school graduates (18.5%), 369 (16.8%) had graduate degree, and

Table 1
Descriptive analysis.

	Mean	SD	N	Percentage
Age	58.07	15.72		
Missing			45	2.1%
Gender				
Male			892	40.70%
Female			1152	52.60%
Missing			147	6.7%
Education				
Less than high school			155	7.10%
High school degree			406	18.50%
Some college			652	29.80%
Bachelor's degree			550	25.10%
Post-baccalaureate degree			369	16.80%
Missing			59	2.7%
Physical Health	3.25	0.90		
Missing			6	0.3%
Mental Health	3.49	0.72		
Missing			41	1.9%
PCC	3.97	2.81		
Electronic Communication	0.93	0.97		
Tracking	0.68	0.80		
GenObCon	2.81	0.90		
Missing			111	5.1%
CanObCon	0.99	0.80		
Missing			60	2.7%
Moderate Exercise	2.58	2.23		
Missing			19	0.9%

Note. GenObCon = Beliefs about genetics-obesity connection; CanObCon = Beliefs about cancer-obesity.

155 (7.1%) did not finish high school. For health status, most respondents (N = 1785, 81.5%) reported good to excellent physical health, and 1810 (82.6%) reported good to excellent mental health, suggesting that most respondents were physically or psychologically healthy (Table 1).

3.2. Bivariate correlations

Bivariate analysis shows that one's engagement in moderate exercise more often during the pandemic was correlated with a younger age (β = −0.10, p < .01), being male (β = −0.14, p < .01), having higher educational background (β = 0.13, p < .01), being physically (β = 0.26, p < .01) and mental well (β = 0.12, p < .01), having more frequent e-communication with providers (β = 0.11, p < .01), more firmly believing that obesity causes cancer (β = 0.12, p < .01), and being more likely to track their health (β = 0.18, p < .01) (Table 2).

Better PCC was correlated with more frequent e-communication with providers (β = 0.04, p < .01), more firmly attributing obesity to genetics (β = 0.04, p < .05), and less attributing cancer to obesity (ß = −0.05, p < .05). Having frequent e-communication with providers was also correlated with attributing obesity to genetics (β = 0.09, p < .01), more firmly believing that obesity causes cancer (β = 0.11, p < .01), and more frequent health tracking using electronic devices (β = 0.36, p < .01).

In addition, attributing obesity to genetics was correlated with believing that obesity causes cancer (β = 0.12, p < .01) and more frequent health tracking (β = 0.05, p < .05). Believing that obesity causes cancer was also correlated with more frequent health tracking (β = 0.15, p < .01).

3.3. Structural equation modeling

As the results show, the model had a good fit ($X^2(0)$ = 0, p < .01, RMSEA = 0, CFI = 1, SRMR = 0). Since PCC was not associated with PA (ß = −0.01, p = .53), H1 was not accepted.

Factors contributing to frequent e-communication with providers included better PCC (ß = 0.02, p < .001), younger age (β = −0.007, p < .001), and higher education (β = 0.08, p < .001). Since e-communication predicted increased moderate exercise (β = 0.12, p = .02), H2 was accepted.

Frequent health tracking (β = 0.28, p < .001) was also a significant predictor of increased moderate exercise. H3 was accepted.

Factors associated with frequent health tracking included frequent e-communication with providers (β = 0.23, p < .001), believing that obesity causes cancer (β = 0.09, p < .001), older age (β = −0.01, p < .001), higher educational background (β = 0.02, p = .01), and good physical health (β = 0.09, p < .001). H4 was partially accepted.

Factors associated with believing obesity causes cancer included frequent e-communication with providers (β = 0.08, p < .001), being male (β = −0.02, p = .02), higher educational background (β = 0.04, p < .001), good physical health (β = 0.05, p = .01), and poorer mental health (β = −0.7, p = .01).

Factors associated with attributing obesity to genetics included frequent e-communication with providers (β = 0.07, p = .002), better PCC (β = 0.02, p = .03), and poorer mental health (ß = −0.06, p = .049).

Other significant predictors of doing moderate exercise included firmly believing that obesity causes cancer (ß = 0.25, p < .001), attributing obesity to genetics (ß = −0.11, p = .047), frequent health tracking (ß = 0.28, p < .001), being male (ß = −0.05, p = .01), good physical (ß = 0.52, p < .001) and mental health (ß = 0.27, p < .001) (Fig. 2). H5 was partially accepted.

4. Discussion and conclusion

4.1. Discussion

This study examined the predictors of moderate exercise for overweight patients during the COVID-19 pandemic. The findings suggested that e-communication with providers, using health-tracking technologies, and beliefs about obesity were the main predictors of patients' exercising. Our results showed how such predictors were interrelated and associated with patient-centered communication.

In line with previous research [40], PCC was significantly associated with causal beliefs around how genetics may determine obesity. This suggests that a good therapeutic relationship can reduce patients' weight-related self-blame. Nevertheless, it may produce fatalistic thinking [49] and lower patients' self-efficacy for weight management. Previous research showed that obesity-related beliefs influenced one's health behaviors [13]. Our research extends these findings by examining similar attributions within the context of the early days of the COVID-19 pandemic, a time when PA was increasingly difficult. Therefore, while educating patients

Table 2
Bivariate correlations.

	Age	Gen	Edu	PH	MH	Ex	PCC	EC	GC	CC	Track
Ex	−0.10**	−0.14**	0.13**	0.26**	0.12**	1					
PCC	0.08**	0.02	−0.02	0.10**	0.15**	0.02	1				
EC	−0.17**	0.01	0.28**	0.06**	−0.03	0.11**	0.04*	1			
GC	−0.01	0.08**	0.074**	−0.04	−0.04	−0.03	0.04*	0.09**	1		
CC	−0.08**	−0.03	0.18**	0.06**	−0.06**	0.12**	−0.05*	0.11**	0.12**	1	
Track	−0.34**	0.11**	0.25**	0.17**	−0.05*	0.18**	−0.01	0.36**	0.05*	0.15**	1

Note. *: p < .05, **: p < .01.Gen = Gender; Edu = Education; PH = Physcal Health; MH = Mental Health; Ex = Exercise; PCC = Patient-centered communication; EC = Electronic Communication; GC = Beliefs about genetics-obesity connection; CC = Beliefs about cancer-obesity connection; T = Track.

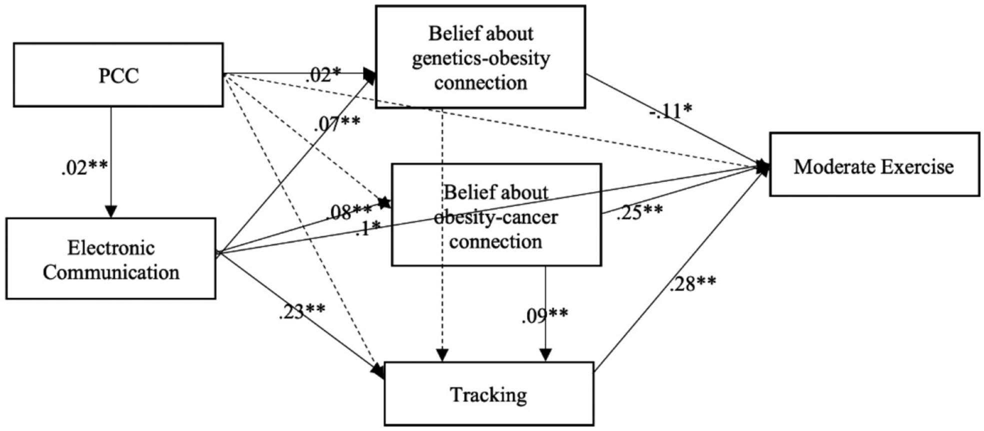

Fig. 2. Structural Equation Model. *Note.* *: $p < .05$, **: $p < .01$. Solid lines represent significant paths; dashes represent insignificant paths.

[38], providers may specifically address genetics-related fatalism to motivate overweight patients to exercise and track their health often. For example, providers should promote the benefits of PA unrelated to weight status, including reduced cancer-related mortality risks [50] and improved psychosocial outcomes (e.g., increased feelings of acceptance and control for young adult cancer patients) [51]. As self-regulation theory suggested [52], positive forethoughts of specific actions help people become more proactive in such actions.

Since preventive strategies (e.g., social isolation) during COVID-19 required some healthcare services to go online, patients' contacting their providers electronically led to positive changes in their health-related beliefs and behaviors. Our findings showed that more frequent e-communication with providers was associated with better knowledge on obesity-related causes and effects, health-tracking behaviors, and moderate exercise. This reflects previous research on how patient portals can enhance patients' accessibility to useful medical information [53]. Especially for patients with chronic diseases like obesity, their need for online information regarding weight management [54] can be satisfied by their providers who can help them engage in long-term exercising program [55]. Also, while PCC did not directly predict beliefs about obesity's effects on cancer or obesity management behaviors, it was related to them by motivating patients' uses of e-communication. This supports previous research on how PCC can enable ongoing self-management of chronic illness [56]. Therefore, integrating PCC into e-communication and discussing mHealth technologies may be great strategies to engage overweight patients in PA. This is particularly important as COVID-19 moves towards an endemic status, with regularly occurring surges.

In addition to e-communication, health-tracking technologies showed potential to facilitate weight management by encouraging exercising. This mechanism may be explained by research on how uses of tracking devices were associated with individuals' increased awareness of health concerns [57]. As pandemic strategies confined people to their homes, health-tracking devices may be a good alarm system reminding individuals of their unfulfilled fitness goals. However, abundant literature cautioned the unproductive side of tracking devices, suggesting that factors such as counterproductive social competition [58,59], frustration over unachieved goals [58], low perceived usefulness [60], and privacy concerns [61] may cause discontinuance of health-tracking devices' adoption. Also, as the digital divide became more pronounced during COVID-19 [62], overweight people with lower socioeconomic status may be further disadvantaged when their lack of access to technologies was compound with reduction of exercise. Research showed that one's surrounding built environment may affect activity level at the population level [63]. Thus, improving accessibility to engage in PA may be particularly important for individuals who live in areas with poorly built environments. Healthcare providers can offer useful information to save time and cost for these patients and help them exercise efficiently during the pandemic.

Perceptions of PCC was significantly related to both obesity-related beliefs and mHealth usage for health tracking purposes. The latter two were associated with moderate exercise during the pandemic. Given our findings, healthcare providers should use PCC techniques like motivational interviewing to ascertain patients' obesity-related beliefs [64]. Understanding such cognitive factors, along with social factors like one's willingness to participate in a Fitbit group challenge, may lead to the development of health interventions that can test health behaviors leading to long-term lifestyle changes.

mHealth may be a tool to improve accessibility, particularly as it looks to offer innovative and flexible options for patients [65]. Providers could ask patients about their digital literacy level to make individualized recommendations. Further, providers can also develop free/low-cost PA resources (e.g., YouTube channels) for patients with lower budgets.

Some limitations exist. As HINTS is a cross-sectional survey, our findings only show correlations, instead of causations, between variables. Researchers may conduct experiments to examine how PCC and technologies can influence PA. Second, HINTS used a gender binary (male/female) in the questionnaire which limits interpretation of the results. Survey designs should seek to use inclusive to improve accuracy. Third, one should take caution when interpreting our results, as the timing of the data collection was unique during the fast-changing phases of the pandemic amidst people's changing behavior, mindsets, and preventive strategies. Also, since our analysis did not incorporate sampling weights, our findings may not be generalizable to the American population. Thus, future research should replicate our findings to explore the general trend of pandemic exercise among the overweight individuals.

4.2. Innovation

Taking over the market for their potential to lead a healthy lifestyle, wearable tracking technologies have gained attention across industry and academia [57]. Specifically, tracking devices may enhance people's perceived health and health-related goal setting [57,61,66]. Although it is unclear if tracking devices are efficient at maintaining long-term self-management for patients needing regular exercise [58,60], previous research overlooked how providers' communication and one's health-related beliefs is related to the use of tracking devices for self-management. Our study examined such effects and found how providers can guide exercising during the pandemic by exchanging information on obesity-related beliefs and technologies with patients. Telehealth communication may also play a powerful role in this regard.

4.3. Conclusion

This study examined secondary data provided by overweight individuals from the early days of COVID-19; this population may benefit from targeted mHealth interventions given that the pandemic's surges continue.

E-communication with providers, belief about how obesity contributes to cancer, and health-tracking behaviors predicted overweight patients' PA during the pandemic. Our findings suggest that healthcare providers should engage patients through mHealth and seek to improve digital health literacy to progress PA nationwide.

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No funding was received for this study.

Declaration of Competing Interest

The authors declare that they have no conflicting or competing interests to report.

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