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Lifestyle Behavior Changes in the Post-Pandemic Era among Young Adults

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ABSTRACT

The COVID-19 pandemic caused massive upheavals to the everyday lives, social, and health practices of young adults, and the impact has far-reaching implications that go beyond the immediate response phase of the health crisis. With societies emerging into the post-pandemic period, it is a critical public health consideration to investigate how behavioral disruptions have continued, healed, or evolved. This cross-sectional, quantitative study investigated the changes in lifestyle behavior and predictors of post-pandemic changes in a group of 200 Pakistani young adults aged 18-30 years, university students and new graduates. Changes in dietary quality, meal regularity, physical activity, sleep patterns, and perceived pandemic impact, digital health resource access, and perceived social support were measured with a structured questionnaire with 5-point Likert scales. Reliability was established through the use of Cronbach alpha (0.76– 0.84). Extensive worsening of behavior was reported including 64.5% reported deterioration in physical activity, 70.0% deterioration in vigorous physical activity, 58.5% deterioration in nutritional quality and 52.0% deterioration in the quality of sleep; ironically 47.0% reported that sleep duration had improved. Multiple regression identified pandemic impact severity ($\beta = -0.381$, $p < 0.001$), digital health access ($\beta = 0.291$, $p < 0.001$), social support ($\beta = 0.239$, $p < 0.01$), and education level ($\beta = 0.138$, $p < 0.05$) as significant predictors of behavioral recovery ($R^2 = 0.370$). The scarring of post-pandemic behavior is prevalent and unevenly distributed, and female, lower-income, and less-educated young adults exhibit persistently poorer recovery. Specialized interventions based on the use of digital health tools and social support networks are urgently required.

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Introduction

Long-term disruption of normal routines due to the pandemic has raised increasing concerns regarding long-term behavioral effects, especially among the youthful populations. Despite the loosening of restrictions, a significant number of people have not been able to resume their pre-pandemic lifestyles. This has prompted growing attention in learning about whether

COVID-19 has resulted in any long-lasting behavioral changes that are not limited to the crisis phase and particularly in the domains of dietary behavior, activity levels, and sleep quality.

Recent literature indicates that the behavioral disruption after the pandemic is not uniformly recovered and may be contingent upon a mixture of psychological, social and structural factors. Potential determinants of recovery have been found to include access to digital health resources, access to social support systems, and severity of pandemic exposure. Nevertheless, there is little evidence that has been offered in the South Asian contexts such as in Pakistan. This paper thus seeks to fill this gap by investigating changes in behavior that take place after the pandemic and predictors of these changes among young adults in Pakistan.

On March 11, 2020, the World Health Organization declared COVID-19 a global pandemic, which prompted responses to the situation in the form of lockdowns, social distancing, closing of institutions, movements, and behavioral disruptions of a scale and scope never seen before [1]. In the case of young adults (18-30) already in the behavioral storm of first-mover adulthood, the pandemic caused a behavioral storm of simultaneous disruption of educational routines, social networks, recreational activities, and early career trajectories, a perfect storm of behavioral vulnerability. The dietary quality, physical activity, and sleep architecture impact were widely reported during the acute pandemic period [3,4,5].

The experience of the pandemic in Pakistan was disruptive. Between 2020 and 2023, the country has suffered five waves of COVID-19 infection [6], which resulted in several rounds of lockdown and 18 months of predominantly online university education. The material resources could not be used to buy healthy food and recreational spending due to economic shocks - informal sector job losses, agricultural interference and remittance losses [7]. With the shift of the nation towards the post-pandemic period, the behavioral health of Pakistani young adults is not sufficiently described.

The behavioral change persisting beyond the acute emergency due to the pandemic, similar to the economic scarring of recessions, has been suggested as one of the important public health issues [8]. Behavioral scarring works based on disruption of habit, development of new sedentary habits, motivational erosion, and maintenance of structural barriers despite the removal of formal restrictions [9]. Colley et al. discovered that, 58% of Canadian adults were below pre-pandemic baseline of physical activity 12 months after restrictions [10]. In seven countries, Morin et al. reported clinically significant insomnia to be above pre-pandemic levels [11].

The moderators of post-pandemic recovery - factors that distinguish a successful recovery process and scarring have significant implications to interventions. The severity of pandemic impact must be negatively predicted by recovery [12], access to digital health resources must mediate behavioral support by technology, recovery [13], and social support must mediate behavioral reinforcement by interpersonal support [14]. The current paper discusses these processes in Pakistani youth adults, considering demographic disparities in recovery pathways.

Study objectives: (1) describe the prevalence and trend of post-pandemic behavioral changes in dietary, physical activity and sleep domains; (2) determine how behavioral worsening is predicted by demographic factors (gender, education, income); (3) whether factors predicting overall behavioral recovery and domain-specific predictor profiles (dietary, physical activity, and sleep recovery) exist.

Literature Review

Behavioral Disruptions in Pandemics: International Evidence

The 22-country survey of 1,047 adults by Ammar et al. revealed an average decrease of 33.5 percent of overall physical activity and an increase of 28.4 percent of sitting time during the first lockdowns, with gym closures (71) and outdoor restrictions (68) as the most significant structural determinants [3]. Smartphone step counts data of 455,404 users in 187 countries recorded by Tison et al. showed that, at the peak of lockdown, step counts had decreased by 27.3 per cent but had not fully recovered six months later with 11.2 per cent still lower than the baseline level [8]. There were also dietary shifts, more home cooking (31-58% of those surveyed), less fast food (24-47%), but also more emotional eating (41-63% in young adults) and more eating ultra-processed foods [4].

Sleep experienced a paradoxical dual change: longer duration in people with eradicated commuting as well as poorer quality caused by anxiety about the pandemic, cognitive arousal during the night, and late sleep onset [5]. Morin et al. followed sleep issues in 13,000 adults across seven waves of the pandemic in seven countries, showing insomnia rates of 37 during the peak of the pandemic and 25 when restrictions disrupted -still high above pre-pandemic levels of 1820% [11].

Post-Pandemic Behavioral Recovery: Persistence Evidence

Colley et al. followed 2,895 Canadian adults at 3 time points and reported only 42% of participants experiencing full physical activity recovery 12 months after lockdown relief and younger adults exhibiting slightly quicker yet still far below-baseline patterns [10]. In their multinational sleep tracking, Morin et al. established the post-pandemic continuation of insomnia as per the cognitive-behavioral insomnia theory: once conditioned sleep arousal is conditioned by the pandemic stress, it is perpetuated by the learned associations without necessarily considering the stressor that triggered it [11]. A study by Martinez-Steele et al. reported that the consumption of ultra-processed food, which increased during lockdowns, did not go back to the pre-pandemic levels even after the complete reopening of food retail stores [15].

Digital Health Technologies as Recovery Facilitators

Hall et al. reported that the number of downloads of applications related to fitness increased globally by 47 percent in the first year of the pandemic, and young adults who continued to have digital health interactions showed considerably improved behavioral outcomes, despite adjusting baseline results before the pandemic [13]. The meta-analysis by Lunde et al. included 21 randomized trials and found that smartphone physical activity interventions yielded the largest effect of $d = 0.54$ with the interventions that included real-time feedback, social comparison, and goal-setting elements having the biggest effect [16]. Ferreri et al. showed that dietary tracking applications users had an improved quality of diet compared to the non-users during the pandemic, which indicates that digital nutritional support can partially replace the institutional dietary support [17].

Behavioral Recovery and Social Support

The meta-analysis by Holt-Lunstad et al. of 148 prospective studies was established to show sufficient social support related to a 50 percent survival probability, where the effects sizes were similar to smoking cessation [14]. The pandemic affected all the four mechanisms of social support such as instrumental, informational, appraisal, and emotional at the same time [18]. Browning et al. discovered that young adults who have suffered more pandemic-related

social network collapse exhibited a slower post-pandemic recovery curve, and self-efficacy reduction (0.34) mediated the association between the two factors predicting behavioral decline (0.41) [19].

Psychological Processes of Behavior Persistence

The theory of habit suggests that behaviors occurring under contextual stimuli as a result of repetition need very little deliberation on the part of the human being [9]. Pandemic disruption generated post-pandemic behavioral inertia that is difficult to reverse without completely removing restrictions by eliminating pre-pandemic healthy behavior contextual cues and establishing new sedentary home-based behavioral links through lockdown repetition. The self-determination theory would predict that intrinsically motivated pre-pandemic health behaviors would be more resilient and quicker to recover than extrinsically motivated behaviors, which are reliant on external social situations and institutional enforcement of routines [20]. The stage-based model of the transtheoretical model forecasts pandemic shocks that shifted many young adults through stages of maintenance to contemplation or preparation necessitating stages-specific intervention reactions [21].

Methodology

Research Design

The study design was a quantitative cross-sectional study in which the changes in the conditions of behavior after the pandemic and the factors predicting them were measured. The research was carried out in 2024, which is the post-acute stage of the pandemic after a large-scale vaccination, the removal of restrictions, and the organization of face-to-face education. The cross-sectional methodology can be used in population-level behavioral snapshots and predictor identification by regression.

Participants and Sampling

The study audience was young adults aged 1830 who lived in Pakistan during the pandemic period (March 2020 -December 2022). Convenience sampling was used, recruiting a sample of 200 respondents at university campuses and community centers throughout Pakistan, and enhanced by distribution online via university student union networks to incorporate recent graduates. Inclusion criteria: 18-30 years of age, permanent Pakistani residence during 2020-2022, ability to recall the behavioral changes, and informed consent. Exclusion criteria: acute COVID-19 illness or hospitalization within three months before the study. The power analysis showed that the minimum effect sizes (f 2 = 0.15) required 80% power with six predictors with a minimum of 100 participants and power of 95% with 200 participants.

Measurement Instrument

The structured questionnaire consisted of seven parts: (1) demographics; (2) Dietary Behavior Change Scale (DBCS, 10 items, adapted [3,4]); (3) Physical Activity Change Scale (PACS, 8 items, adapted IPAQ [22]); (4) Sleep Behavior Change Scale (SBCS, Pilot testing of 25 students resulted in test-retest reliability r = 0.74-0.88. A general Behavioral Recovery Composite Score (average of DBCS, PACS, and SBCS) was the main outcome of regression.

Statistical Analysis

IBM SPSS v.26 was used. Behavioral change distributions were described using descriptive statistics. Scale reliability was measured using Cronbach alpha. Demographic patterning of prevalence of behavioral worsening was tested using chi-square tests. Six predictors were simultaneously introduced in the Behavioral Recovery Composite outcome in multiple

regression: the severity of impact of the pandemic, digital health access, social support, education level, gender, and income. Domain-specific regression models were used to test dietary, physical activity and sleep recovery separately. VIF values ensured that there was no multicollinearity (VIF < 3.8).

Ethical Considerations

Data collection was preceded by ethics committee approval. Informed consent was given in writing by all participants. No personally identifying data was gathered. In patients experiencing high levels of distress, written details of the existing mental health support services were given. All the data were anonymized and kept in secure, access-restricted systems.

Results and Analysis

All questionnaires were filled out (100 percent response). Cronbach's alpha: Dietary Behavior Change ($\alpha = 0.79$), Physical Activity Change ($\alpha = 0.84$), Sleep Change ($\alpha = 0.76$), COVID-19 Impact ($\alpha = 0.82$), Digital Health Access ($\alpha = 0.77$), Social Support ($\alpha = 0.81$),

The demographic profile (Table 1) indicates that it is mostly a young adult sample with most of the respondents being between the age of 22-25 years (43 percent) and are in university (73 percent). The female population was slightly higher (54%), compared to males (46%), whereas the majority of the participants lived in cities (67%). The distribution of income shows that there is a concentration in the middle-income group (49.5%), then there are low-income respondents (30.5%). The high rate of vaccination (86) and almost equal distribution of the status of having a prior COVID-19 infection offer valuable contextual baseline, regarding the interpretation of post-pandemic behavioral outcomes.

Table 2 and Figure 1 (Descriptive findings) indicate that there is a general pattern of behavioral decline in major areas of lifestyle. There was significant deterioration in dietary patterns with over half of those surveyed reporting deterioration in the quality of their diet (58.5%), the frequency of meals (58.5%), and consumption of fruits and vegetables (54.0%), and a significant rise in emotional eating (66.5%). There were also adverse trends in physical activity, with 64.5% of the respondents indicating an overall decrease in activity and 70% indicating a decrease in engaging in vigorous activity. The domain that was most impacted was sedentary behavior, where 75% of the respondents reported more screen time.

Outcomes related to sleep were a relatively ambivalent trend. Although the respondents who reported on sleep duration showed improvement (47%), other aspects of sleep like the quality (52.0%), regularity of time of sleep (57.5%), and anxiety about sleep (73.0%) were worse in a significant proportion. On the whole, the recovery composite shows that almost 60 percent of the individuals surveyed had deteriorated lifestyle patterns, which implies that the effect of the pandemic on everyday life is mostly negative.

Demographic differences further (Table 3) show that there are considerable differences based on gender, education, and income group. There was always a higher rate of behavioral degradation reported by females than by males, especially in physical activity and screen time. In the same vein, those who had lower levels of education had more negative change in all areas. Differences based on income were particularly high, as low-income people showed the most deteriorated diet, physical activity, and sleep quality (62.3 and 75.4), and screen time (83.6). These were statistically significant differences, which highlights the influence of socioeconomic inequality on post-pandemic health behaviors.

To analyze predictive relationships, multiple regression analysis was done (Table 4). This model was statistically significant ($F(6,193) = 18.94$, $p < 0.001$) and accounted 37% of the variance in general behavioral recovery. The severity of impact in a pandemic was found to be the best negative predictor (= -0.381, p = 0.001), which means that more severely affected people were unlikely to show positive changes in lifestyle behaviors. Digital health access (= 0.291, p =0.001) and social support (= 0.239, p =0.001) on the other hand were significant positive predictors, and hence their significance to enable adaptive behavioral changes is paramount. The level of education also also had a moderate positive impact, but gender and income did not play a significant role in the overall model.

Additional details are offered by domain-specific regression findings (Table 5), which show that predictors have different levels of strength and significance across the behavioral domains. The severity of impact of the pandemic had a consistent negative effect on diet, physical activity, and recovery of sleep. Digital health access was the most positively associated with physical activity and dietary recovery, with social support having particularly strong effects on sleep-related outcomes. The gender difference was pronounced in dietary and physical activity recovery as females showed lower levels of recovery, but the income effect was minimal and domain-specific.

On the whole, the results suggest that behavioral recovery following the pandemic is multidimensional and uneven, as the interaction of structural vulnerability, access to digital health resources, and social supports influences it. Although some of them have shown partial recovery, most are still subject to adverse lifestyle changes, which point to the necessity of specific interventions that will focus on both technological access and social inequalities.

Table 1. Demographic Characteristics of the Study Sample (n = 200)

Characteristic	Category	n	%
Gender	Male	92	46.0
	Female	108	54.0
Age Group	18–21 years	73	36.5
	22–25 years	86	43.0
	26–30 years	41	20.5
Education	Currently Enrolled University	146	73.0
	University Graduate (< 2 years)	54	27.0
Residence	Urban	134	67.0
	Peri-urban	66	33.0
Employment	Student Only	112	56.0
	Part-time Employed	51	25.5
	Full-time Employed	37	18.5
Income	Low (< PKR 40,000/month)	61	30.5
	Middle (PKR 40,000–100,000)	99	49.5
	High (> PKR 100,000/month)	40	20.0
Vaccination Status	Fully Vaccinated	172	86.0
	Partially/Unvaccinated	28	14.0
Prior COVID Infection	Yes	94	47.0
	No/Unknown	106	53.0

Table 2: Frequency Distribution of Post-Pandemic Lifestyle Behavior Changes (n = 200)

Behavior Domain	Improved n (%)	Unchanged n (%)	Worsened n (%)	Mean Score	SD
Dietary Quality	48 (24.0%)	35 (17.5%)	117 (58.5%)	2.41	0.88
Meal Regularity	39 (19.5%)	44 (22.0%)	117 (58.5%)	2.38	0.91
Fruit & Vegetable Intake	51 (25.5%)	41 (20.5%)	108 (54.0%)	2.53	0.86
Emotional Eating	29 (14.5%)	38 (19.0%)	133 (66.5%)	2.11	0.87
Physical Activity (Overall)	37 (18.5%)	34 (17.0%)	129 (64.5%)	2.19	0.87
Vigorous Exercise	29 (14.5%)	31 (15.5%)	140 (70.0%)	2.03	0.89
Moderate Exercise	44 (22.0%)	39 (19.5%)	117 (58.5%)	2.34	0.91
Daily Walking/Steps	52 (26.0%)	47 (23.5%)	101 (50.5%)	2.63	0.88
Sedentary Screen Time (R)	21 (10.5%)	29 (14.5%)	150 (75.0%)	1.89	0.81
Sleep Duration	94 (47.0%)	43 (21.5%)	63 (31.5%)	3.22	0.83
Sleep Quality	39 (19.5%)	57 (28.5%)	104 (52.0%)	2.67	0.92
Sleep Timing Regularity	34 (17.0%)	51 (25.5%)	115 (57.5%)	2.49	0.89
Sleep Anxiety (R)	18 (9.0%)	36 (18.0%)	146 (73.0%)	1.92	0.84
Overall Recovery Composite	41 (20.5%)	40 (20.0%)	119 (59.5%)	2.47	0.79

(R) = Reverse-scored. Mean score on 5-point scale; higher = better/improved.

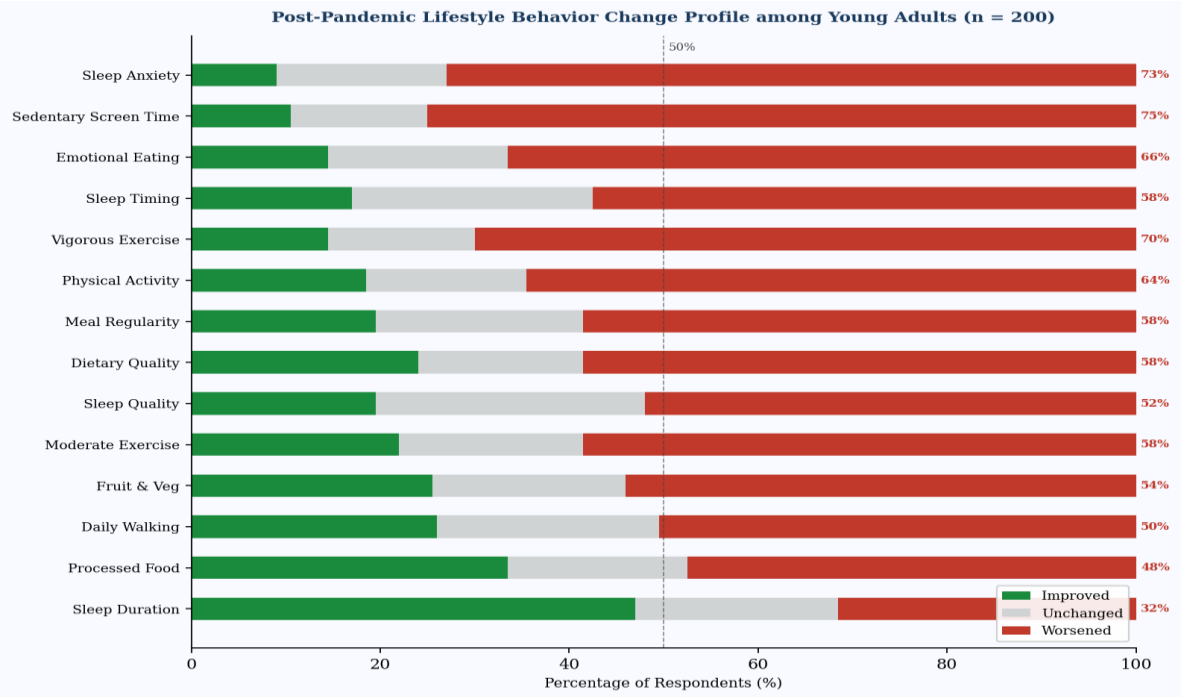

Figure 1: Post-pandemic behavioral change profile (n = 200). Bars show percentage reporting improvement (green), no change (grey), and worsening (red) per domain. Domains ranked by worsening prevalence. The red percentage labels indicate the proportion reporting behavioral deterioration.

Table 3: Demographic Patterning of Post-Pandemic Behavioral Worsening (% Deteriorated)

Variable	Physical Activity	Dietary Quality	Sleep Quality	Screen Time
Male	59.8%	52.2%	44.6%	70.7%
Female (χ^{2*})	68.5%	63.9%	58.3%	78.7%

University Educated	61.0%	54.8%	48.1%	72.3%
Secondary Educated (χ^2*)	72.7%	68.2%	61.4%	80.9%
High Income	48.0%	41.8%	38.3%	62.5%
Middle Income	63.6%	57.6%	52.5%	73.7%
Low Income (χ^2**)	75.4%	72.1%	62.3%	83.6%

** $p < 0.05$; ** $p < 0.01$. χ^2 tests compare full distribution (improved/unchanged/worsened) across groups.*

Table 4: Multiple Regression - Predictors of Post-Pandemic Behavioral Recovery (n = 200)

Predictor	B	SE	β	t	p	95% CI
Pandemic Impact Severity	−0.418	0.071	−0.381	−5.89	< 0.001	[−0.558, −0.278]
Digital Health Access	0.312	0.070	0.291	4.48	< 0.001	[0.175, 0.449]
Social Support	0.256	0.078	0.239	3.27	0.001	[0.101, 0.411]
Education Level	0.161	0.079	0.138	2.03	0.044	[0.004, 0.318]
Gender (Female = 1)	−0.118	0.088	−0.091	−1.34	0.182	[−0.292, 0.056]
Income Level	0.089	0.065	0.094	1.37	0.173	[−0.039, 0.217]
R^2 = 0.370; Adj. R^2 = 0.350	F(6,193) = 18.94	p < 0.001				

Table 5: Domain-Specific Regression Results — Standardized β Coefficients

Predictor	Dietary Recovery	Physical Activity Recovery	Sleep Recovery	Overall Recovery
Pandemic Impact Severity	−0.342***	−0.418***	−0.289***	−0.381***
Digital Health Access	0.318***	0.361***	0.198**	0.291***
Social Support	0.281***	0.187**	0.261***	0.239***
Education Level	0.151*	0.119 ns	0.142*	0.138*
Gender (Female)	−0.143*	−0.168*	−0.101 ns	−0.091 ns
Income Level	0.112 ns	0.127*	0.083 ns	0.094 ns
R^2	0.321	0.388	0.279	0.370

** $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ns = not significant*

Discussion

The ubiquitous nature of the pattern of behavioral scarring observed in this research - an escalating prevalence of 75.0% in sedentary screen time, 73.0% in sleep anxiety, 70.0% in vigorous exercise, 66.5% in emotional eating, and 64.5% in overall physical activity - supports the conclusion that post-pandemic behavioral rehabilitation is The sleep paradox (enhanced duration (47.0%), deteriorated quality (52.0%), regularity of the timing (57.5%), and sleep anxiety (73.0%)) is also the duplication of the COVID-insomnia pattern [5] and the validation of the continuation of conditioned sleep arousal after the acute pandemic phase [11].

The strongest modifiable positive predictor (B = -0.291) is the digital health access which has an immediate policy implication. It's especially high impact on physical activity recovery (0.361) is consistent with the meta-analytic findings on fitness apps [16] and can be used strategically to invest in institution-approved digital physical activity applications with subsidies on their use by economically disadvantaged students. The high dietary recovery prediction (B = 0.281) and sleep recovery prediction (B = 0.261) of social support, which

indicates the centrality of interpersonal behavioral scaffolding shared meals, regular sleep environment, peer accountability in helping to recover in these domains, the need to invest in peer support and community health programs that restore the social networks the pandemic destroyed [14,19].

The results of the demographic inequity are depressing: the worsening of behavior is more common in the case of female, lower-income, and secondary-educated respondents. The barriers to physical activity that exist in females, such as limited access to gender-separate areas, disproportionate workload at home, increased pandemic anxiety, are to be met with gender-sensitive programmatic interventions [25]. The financial barrier on healthy food, gym membership, and digital tool subscription is in need of subsidized solutions concerning low-income young adults whose recovery is the most adversely affected due to the lack of material resources.

Conclusion

Behavioral scarring in post-pandemic Pakistani young adults is prevalent, clinically relevant, and unevenly spread, as most participants noted continued declines in physical activity, nutritional quality, sleep quality, and sedentary behavior, as well as emotional eating. The severity of pandemic impact, level of digital access to health, social support, and the level of education are important modifiable recovery predictors. The most practical recommendations include: (1) institutional encouragement of subsidized digital means of health promotion in physical activity, nutrition and sleep; (2) peer support programs in the community that restores interpersonal behavioural scaffolding; (3) gender sensitive physical activity programs that overcome structural barriers to female recovery; (4) mental health support that accounts the severity of pandemic impact as a precondition to behavioural rehabilitation; and (5) post-Longitudinal designs, objective behavioral measurement, and randomized intervention evaluations should be used in future studies in the context of post-pandemic rehabilitation.

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