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Economic, Health, and Social Factors Associated with Post-COVID-19 Behavioral Change: A Cross-Sectional PLS-SEM Study

Titik Respati[1a*], Susan Fitriyana[1b], Nurul Romadhona[1c], Indra Fajar Alamsyah[2d], Noor Zahirah Mohd Sidek[3e], Muhammad Hanif Othman[3f], Wanti Wanti[4g], Tri Wahyuni[5h]

[1] Faculty of Medicine, Universitas Islam Bandung, Indonesia
[2] Faculty of Economy and Business, Universitas Islam Bandung, Indonesia
[3] Faculty of Economy and Business, Universitas Technology Mara, Kedah, Malaysia
[4] Poltekkes Kemenkes Kupang, Kupang, Indonesia
[5] Institute for Research and Community Services, Universitas Islam Bandung, Indonesia

[a] Email address: titik.respati@unisba.ac.id
[b] Email address: susanfitriyananugraha@gmail.com
[c] Email address: nurulromadhonadokter@gmail.com
[d] Email address: indrafajaralamsyah@gmail.com
[e] Email address: nzahirah@uitm.edu.my
[f] Email address: hanifothman@uitm.edu.my
[g] Email address: trivenawanti@gmail.com
[h] Email address: trwyni@gmail.com

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Abstract
The post-COVID-19 period has involved economic, health, and psychosocial changes that may influence behavioral adaptation. This study examined the associations of economic impact, health impact, social support, and emotional well-being with behavioral change and tested whether income moderated these associations. A cross-sectional survey included 215 adults aged 18 years or older. Data were analyzed using partial least squares structural equation modeling (PLS-SEM). Economic impact (beta = -0.245, $p < 0.001$) and emotional well-being (beta = -0.228, $p = 0.001$) were significantly associated with behavioral change. Health impact, social support, and income had no statistically significant direct associations. None of the income interaction terms was significant (all $p > 0.05$), providing no evidence that income moderated the tested relationships. Post-pandemic behavioral change was associated most clearly with economic impact and emotional well-being in this sample. Recovery programs should therefore integrate economic protection with psychosocial support, while longitudinal studies are needed to establish temporal and causal relationships.

Keywords: behavioral change; post-COVID-19 recovery; socioeconomic determinants; emotional well-being; income moderation.

Corresponding Author:

Titik Respati
Faculty of Medicine, Universitas Islam Bandung, Indonesia
Email: titik.respati@unisba.ac.id

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1. INTRODUCTION

The COVID-19 pandemic disrupted economic security, healthcare access, social relationships, and everyday behavior worldwide. Although acute clinical outcomes initially dominated research, the post-pandemic period has drawn attention to persistent financial strain, health consequences, psychological distress, and weakened support systems that may shape behavioral adaptation (Panneer et al., 2022).

Behavioral responses after COVID-19 are heterogeneous. Economic disruption, including job loss, reduced income, and increased household expenditure, may constrain healthcare use and healthy choices. At the same time, stress, anxiety, and depression can alter motivation and coping behavior, with greater burdens often experienced by socioeconomically disadvantaged groups (Lu & Lin, 2021; Tizzani & Gauvin, 2024).

Social support may facilitate access to practical resources, emotional reassurance, and health information, but its relationship with behavior can depend on context and the availability of services. These intertwined biological, psychological, social, and economic pathways are consistent with a biopsychosocial perspective and are particularly relevant in low- and middle-income settings (Banati et al., 2020; Bann et al., 2021; Chigangaidze, 2020).

Few studies have examined economic impact, health impact, social support, and emotional well-being in a single post-COVID-19 model while testing whether income changes the strength of their associations with behavior. Therefore, this study aimed to examine the direct associations of these factors with behavioral change and to assess income as a moderator using partial least squares structural equation modeling (PLS-SEM).

2. RESEARCH METHOD

This cross-sectional quantitative study was conducted as an online survey among Indonesian adults during the post-COVID-19 period. Eligible participants were aged 18 years or older, resided in Indonesia, could access and understand the online questionnaire, and provided electronic informed consent. Data collection was conducted after ethics approval was granted in 2024. Because recruitment used an openly shared survey link rather than a predefined population list, no conventional sampling frame was available and participants were selected using non-probability convenience sampling with voluntary response.

The questionnaire was administered through Google Forms. The survey link was distributed through the researchers' social-media networks and could be forwarded by recipients. The opening page explained the study purpose, eligibility criteria, voluntary nature of participation, confidentiality protections, and the right to stop before submission. Only respondents who confirmed consent continued to the questionnaire. Submitted responses were screened for eligibility and completeness; 215 eligible adults provided complete outcome data and were included in the analysis, and no questionnaires were excluded for incomplete outcome data. Because the open link could be viewed or shared an unknown number of times, the number of people invited and the response rate could not be determined, and no random-selection procedure was used.

A post hoc sample-size adequacy check was conducted for the most complex structural equation, which contained nine predictors when the main effects and income interaction terms were considered together. For a multiple-regression approximation with nine predictors, a medium effect size ($f^2 = 0.15$), alpha = 0.05, and 80% power required a minimum of 114 participants; therefore, the analytical sample of 215 exceeded this benchmark (Faul et al., 2009). The study may nevertheless have had limited power to detect small interaction effects.

Data were collected using a structured, previously validated questionnaire that was transferred to Google Forms without changing the validated wording or response options. The instrument measured economic impact, health impact, social support, emotional well-being,

income, and behavioral change. Sociodemographic variables included sex, age, residence, marital status, religion, education, occupation, employment type, and monthly expenses. Construct scores were calculated from their corresponding items according to the validated scoring scheme before PLS-SEM analysis.

Before the main survey was opened, the questionnaire had undergone validity and reliability testing. Only items confirmed as valid and reliable were retained in the final Google Form. The online version was checked to ensure that question order, wording, response options, required fields, and item coding were consistent with the validated questionnaire, and the same form was used for all participants. Indicator labels in the PLS-SEM dataset corresponded to the items in the validated questionnaire. Descriptive statistics were used to summarize participant characteristics. PLS-SEM was used to assess the measurement and structural models. The structural analysis estimated direct paths from economic impact, health impact, social support, emotional well-being, and income to behavioral change, together with product terms testing whether income moderated each predictor-outcome relationship. Statistical significance was set at $p < 0.05$.

The study protocol received Research Ethics Committee approval (no. 011/B.004/KEPSOSHUM/X/2024). Electronic informed consent was obtained before participants accessed the questionnaire, and responses were analyzed in de-identified form.

3. RESULTS AND DISCUSSION

Table 1. Respondents Characteristics

Characteristic	Category	n	%
Sex	Male	89	41.4
	Female	126	58.6
Age (years)	17-30	84	39.1
	31-50	105	48.8
	>51	25	11.6
	Not reported	1	0.5
Residence	Urban	146	67.9
	Rural	69	32.1
Marital status	Married	84	39.1
	Single	128	59.5
	Not reported	3	1.4
Religion	Islam	191	88.8
	Protestant	21	9.8
	Catholic	2	0.9
	Buddhism	1	0.5
Religion	Islam	191	88.8
	Protestant	21	9.8
	Catholic	2	0.9
	Buddhism	1	0.5
Education	Master's degree	28	13.0
	Bachelor's degree	104	48.4
	Diploma	22	10.2
	Senior high school	57	26.5
	Junior high school	4	1.9
Occupation	Student/not working	57	26.5
	Private-sector employee	47	21.9
	Civil servant	38	17.7
	Self-employed	35	16.3
	Worker	14	6.5
	Lecturer	8	3.7

	Other	6	2.8
	Doctor	4	1.9
	Retiree	1	0.5
	Not reported	5	2.3
Employment type	Full-time	97	45.1
	Part-time	18	8.4
	Self-employed	32	14.9
	Other	63	29.3
	Not reported	5	2.3
Monthly expenses	> IDR 10,000,000	21	9.8
	IDR 5,000,001-10,000,000	53	24.7
	IDR 2,000,001-5,000,000	85	39.5
	< IDR 2,000,000	56	26.0

Table 1 summarizes the 215 participants. Women represented 58.6% of the sample, 48.8% were aged 31-50 years, and 67.9% lived in urban areas. One participant did not report age, while five did not report occupation or employment type; percentages in the revised table use the full sample (n = 215) as the denominator.

Measurement model assessment

Supplementary Figure 1 shows outer loadings ranging from 0.332 to 0.949. The highest loadings were observed for B7 (0.949), E8 (0.854), C5 (0.816), C4 (0.810), F5 (0.781), D2 (0.759), and E9 (0.707). Other indicators were below 0.70: D1 (0.672), F2 (0.618), E5 (0.599), F6 (0.591), F8 (0.506), D5 (0.494), and B8 (0.332). These values were considered when interpreting the structural model because weak indicator loadings may reduce measurement precision.

Structural model and income moderation

Table 2 presents the structural paths and income interaction terms. Economic impact had the largest statistically significant association with behavioral change (beta = -0.245, p < 0.001), followed by emotional well-being (beta = -0.228, p = 0.001). Health impact, social support, and income were not significantly associated with behavioral change.

The principal finding was that economic impact and emotional well-being were associated with behavioral change, whereas health impact and social support were not. This pattern supports a biopsychosocial interpretation in which behavioral adaptation reflects more than perceived health consequences alone and may be shaped by material constraints and psychological resources (Chigangaidze, 2020; Lu & Lin, 2021).

Table 2. Respondents Characteristics

Path	**beta**	**Mean**	**SD**	**t**	**p**
Economic impact -> Behavioral change	-0.245	-0.246	0.068	3.603	<0.001
Health impact -> Behavioral change	-0.094	-0.088	0.108	0.867	0.193
Social support -> Behavioral change	-0.007	-0.073	0.075	0.097	0.461
Emotional well-being -> Behavioral change	-0.228	-0.221	0.070	3.267	0.001
Income -> Behavioral change	-0.004	-0.002	0.077	0.054	0.479
Income x Health impact -> Behavioral change	0.020	0.027	0.070	0.286	0.388
Income x Emotional well-being -> Behavioral change	-0.063	-0.061	0.074	0.858	0.195
Income x Social support -> Behavioral change	-0.059	-0.049	0.091	0.644	0.260
Income x Economic impact -> Behavioral change	0.007	-0.003	0.092	0.076	0.470

Economic impact. Economic impact had the largest absolute direct coefficient in the model (beta = -0.245, p < 0.001), indicating that material disruption was more closely associated with behavioral change than perceived health impact, social support, or income after simultaneous adjustment. Economic disruption can influence behavior by changing the

affordability of healthcare, transport, nutritious food, and other resources needed to maintain healthy routines. Job instability and financial uncertainty may also shift attention toward immediate household needs, making longer-term preventive behavior more difficult to sustain. This interpretation is consistent with evidence that the financial consequences of COVID-19 occurred across countries and socioeconomic groups and that post-pandemic protective behaviors remain socially patterned (Khetan et al., 2022; Tizzani & Gauvin, 2024). The economic-impact indicators showed mixed measurement strength, with loadings of 0.599 for E5, 0.854 for E8, and 0.707 for E9. Because the scoring direction has not yet been fully documented, the negative coefficient should be interpreted as an inverse association between the observed construct scores; its substantive meaning as more or less adaptive behavior depends on the final confirmed coding.

Emotional well-being. Emotional well-being was the second significant predictor (beta = -0.228, p = 0.001). Unlike several other constructs, its two indicators had consistently strong loadings, with C4 = 0.810 and C5 = 0.816, supporting a comparatively coherent representation of this variable. Psychological strain may affect behavioral adaptation through reduced concentration, motivation, perceived control, and capacity for self-regulation, whereas emotional stability may help individuals evaluate risks and sustain protective routines. This interpretation is relevant in Indonesia, where an earlier nationwide survey found that more than one-third of respondents experienced at least mild psychological distress during the pandemic (Respati et al., 2021). Evidence also links pandemic-related mental health problems with coping behavior, although the relationship can operate in both directions (Rajkumar, 2020; Onyeso et al., 2025). Consequently, the present cross-sectional result cannot establish whether emotional well-being shaped behavior, behavioral disruption affected emotional well-being, or both occurred together.

Health impact. Health impact was not significantly associated with behavioral change after adjustment for the other variables (beta = -0.094, p = 0.193). One explanation is that perceived health consequences may have become less salient or more normalized in the post-pandemic period, reducing variation in responses. Health impact may also influence behavior indirectly through emotional distress, financial consequences, healthcare access, or risk perception rather than through a single direct pathway. Measurement should also be considered: B7 had a very strong loading of 0.949, whereas B8 loaded only 0.332, indicating that the two indicators did not represent the construct with equal precision. This weak indicator may have attenuated the estimated path. The nonsignificant coefficient therefore should not be interpreted as evidence that health concerns are irrelevant; previous research shows that health information and perceived risk translate into action only when resources, trust, and practical access allow people to respond (Marzo et al., 2022; Panneer et al., 2022).

Social support. Social support had a near-zero direct association with behavioral change (beta = -0.007, p = 0.461). Conceptually, social support can provide emotional reassurance, practical assistance, and information, but the availability of support does not necessarily mean that support is received, appropriate, or sufficient to change behavior. Its effects may be indirect, operating through emotional well-being, access to services, or collective efficacy, and may depend on the quality and source of support. The measurement model also showed variable indicator performance: D2 loaded 0.759, D1 loaded 0.672, and D5 loaded 0.494. The lower-loading items may have reduced sensitivity to meaningful differences in support. In addition, recruitment through social media may have selected relatively connected respondents and restricted variation in social-network access. These considerations are consistent with biopsychosocial accounts in which social resources interact with psychological and economic circumstances rather than functioning as an isolated determinant (Banati et al., 2020; Chigangaidze, 2020).

Income. Income had no statistically significant direct association with behavioral change (beta = -0.004, p = 0.479). This finding is not inconsistent with the significant economic-impact

pathway because current income and experienced economic disruption represent different dimensions. People with similar income may differ substantially in household size, debt, employment stability, savings, caregiving responsibilities, and local living costs. Conversely, a person with a relatively high income may still experience a major pandemic-related financial shock. The supplementary model represents income as a single observed indicator, which is unlikely to capture this multidimensional financial context. Socioeconomic research similarly indicates that different indicators, such as employment, education, and material resources, may relate differently to protective behavior (Bann et al., 2021; Tizzani & Gauvin, 2024). The nonsignificant direct path should therefore be interpreted as a limitation of the measured income variable, not as evidence that socioeconomic position has no behavioral relevance.

Income as a moderator. None of the interaction terms was statistically significant. The p-values shown in Supplementary Figure 2 were 0.388 for income x health impact, 0.195 for income x emotional well-being, 0.260 for income x social support, and 0.470 for income x economic impact. These are moderation rather than mediation tests and indicate that the observed predictor-behavioral change associations did not vary detectably across income levels. Interaction effects are typically more difficult to detect than direct effects, particularly when the moderator has limited variability, is measured with a single item, or is divided into broad categories. Measurement error in several predictor and outcome indicators may have further reduced statistical power. Income could also operate through thresholds or nonlinear patterns that were not represented by the product-term model. Accordingly, the results provide no evidence of moderation in this sample, but they do not prove that income can never modify these relationships in a larger or more socioeconomically diverse population.

Behavioral change. The model explained only a small proportion of variance in behavioral change (R-squared = 0.0149). Measurement of the outcome was also uneven: F5 had a loading of 0.781, while F2, F6, and F8 loaded 0.618, 0.591, and 0.506, respectively. This suggests that the behavioral-change construct may combine different forms of adaptation that were not equally represented by its indicators. Most behavioral variation therefore remains attributable to factors outside the model, potentially including risk perception, health literacy, trust in institutions, access to services, prior infection, vaccination experience, local policy exposure, and established habits. The significant economic and emotional paths identify relevant correlates, but their predictive contribution is limited and should not be presented as a comprehensive explanation of post-COVID-19 behavior (Bann et al., 2021; Perez et al., 2024).

Taken together, the variable-specific findings support a selective biopsychosocial interpretation rather than a model in which every domain exerts an independent direct effect. Economic impact and emotional well-being emerged as the clearest correlates, while health impact and social support may operate through indirect or context-dependent pathways. Health authorities and local governments should therefore combine psychosocial services with economic and social-protection measures, while continuing to provide accessible health information and strengthen practical community support. Healthcare providers may also consider screening for financial strain and emotional distress when supporting post-COVID-19 behavioral recovery. These recommendations align with broader calls to address health, decent work, and inequality together (Panneer et al., 2022; Perez et al., 2024).

This study has several limitations. Its cross-sectional design precludes causal or temporal conclusions, including claims about moderation. Self-reported measures may be affected by recall and social-desirability bias. Recruitment through an open social-media link used convenience sampling, so the number invited and response rate could not be calculated; adults without internet or social-media access may also be underrepresented. These features may introduce self-selection bias and limit generalizability beyond the online sample. Several indicator loadings were below 0.70, the income variable was represented by a single indicator,

and the model explained little variance in behavioral change. These measurement constraints may have attenuated both direct and interaction effects. The nonsignificant interactions may also reflect limited power to detect small moderation effects. Longitudinal, multisite studies should use more comprehensive validated measures, probability-based sampling, and tests of indirect and nonlinear pathways.

4. CONCLUSION

Economic impact and emotional well-being were significantly associated with post-COVID-19 behavioral change in this cross-sectional sample, while health impact, social support, income, and all income interaction terms were not significant. The findings do not support income as a moderator and should not be interpreted causally. Local governments and health services should integrate economic protection, referral for financial support, and psychosocial care into post-pandemic recovery programs. Future longitudinal and multisite research should use fully validated instruments and test how these factors change over time.

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