

Economic Impacts of Mental Health in Northern Virginia

Technical Appendix

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1. Findings Summary

In the past 20 years, mental health has been identified as among the most widespread health issues in the developed world. Given the breadth of mental health issues in our society, it is natural that numerous costs associated with the problem can be identified. Costs include societal costs (e.g., public and private spending on healthcare), quality of life costs (e.g., self-inflicted injuries, premature death), and economic output losses (e.g., reduced labor force participation, absenteeism, presenteeism). Within economic output losses, absenteeism is defined as workers missing scheduled work, while presenteeism refers to situations in which workers are present but produce less due to a lack of full concentration. This report estimates economic output losses from absenteeism and presenteeism by applying estimated losses from absenteeism and presenteeism to the estimated share of the working population in Northern Virginia suffering from mental health issues. In this appendix, summarized findings are followed by more detailed findings before providing expanded details of the data, methodology, and limitations.

Overall, economic output losses stemming from absenteeism and presenteeism from mental health are substantial. In particular:

- Mental health induced absenteeism and presenteeism losses in Northern Virginia increased from \$2.1 billion in 2019 (0.9%) to \$8.0 billion in 2020 (3.4%) as mental health issues proliferated as a result of the pandemic.
- Mental health losses in Northern Virginia subsided somewhat to 3.2% in 2021 and 3.0% in 2022 as stresses associated with the pandemic have moderated.
- The same losses also increased in the Commonwealth of Virginia but have not abated along with Northern Virginia as mental health issues at the state level increased from 2021 to 2022.
- The share of Virginia's output losses accounted for by Northern Virginia declined from 47% in 2019 to 38.6% in 2022, as mental health rates have declined modestly in Northern Virginia but increased at the state level.
- Fairfax County lost an estimated \$4.2 billion in economic output in 2022, 3.0% of potential output, due to presenteeism and absenteeism.
- The Professional and Business Services sector in Northern Virginia is estimated to have lost \$2.3 billion in economic output in 2022, or 2.7% of total potential GRP for the sector.
- The sectors estimated to have had the largest percent losses are Trade, Transportation, and Utilities (4.0%); Leisure and Hospitality (3.9%), Financial Activities (3.8%), and Education and Health Services (3.8%).

While the output losses for the region caused by absenteeism and presenteeism associated with mental health issues are considerable.

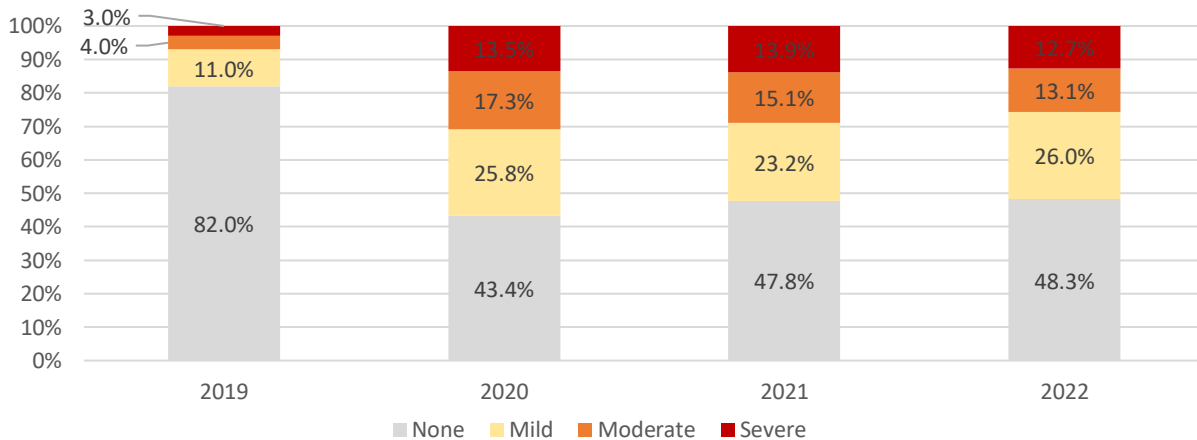
2. Findings

This section provided economic impacts of absenteeism and presenteeism. Estimates provided adjust regional economic output by the share of workers in the region suffering from mental health issues, and by estimated losses from absenteeism and presenteeism associated with mental health issues. Importantly, estimates account for the fact that not all presenteeism hours are completely lost, and that co-workers can account for some of the productivity losses from absent co-workers or those suffering from presenteeism issues.^{i,ii,iii} The methodology section provides additional detail.

2.1 Anxiety and Depression in Northern Virginia

Following the onset of the pandemic, the share of workers with anxiety or depression increased alarmingly. The share of workers with anxiety or depression increased from 18% in 2019 to 56.6% in 2020. While the percent of workers with anxiety or depression declined to 51.7% in 2022, the share remained notably elevated nearly two years after the onset of the pandemic. The share of workers with severe anxiety and or depression declined from 13.5% in 2020 to 12.7% in 2022. Likewise, the share of workers with moderate anxiety or depression declined from 17.3% in 2020 to 13.1% in 2022. In contrast, the share of workers with moderate anxiety or depression was relatively flat, increasing from 25.8% in 2020 to 26% in 2022, perhaps the result of more severe cases diminishing but not being completely resolved.

Figure 1. Share of Workers with Anxiety or Depression: Northern Virginia



Source: Census Bureau Pulse Survey; Community Foundation for Northern Virginia

The share of workers with anxiety or depression varies notably by the sector of the economy. The Financial Activities sector had the greatest share of workers with anxiety or depression in 2022 at 61.2%. The Education and Health Services sector had the second highest share of workers with anxiety or depression at 60.9%. The Professional and Business Services sector, notable as it is the region's largest sector by jobs and output, had 46.7% of its workforce experiencing anxiety or depression in 2022. Given that there were an estimated 313,000 jobs in the Professional and Business Services sector in 2020, this report estimates nearly 146,000 Northern Virginia workers in the sector experienced anxiety or depression.

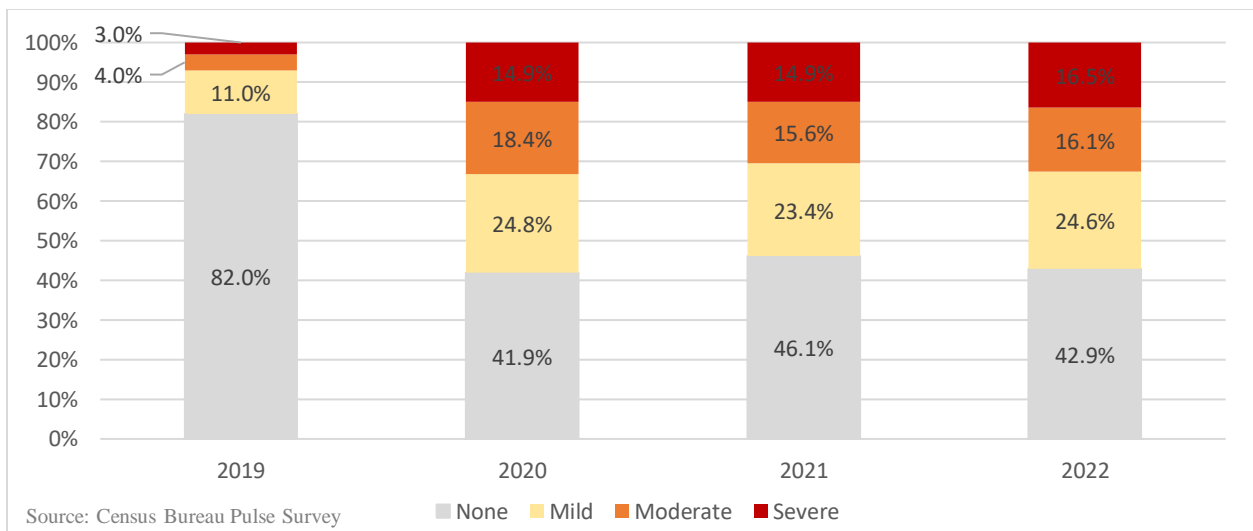
Table 1. Share of Workers with Anxiety or Depression by Economic Sector: Northern Virginia (2022)

Sector	None	Any Anxiety or Depression
Financial Activities	38.8%	61.2%
Education and Health Services	39.1%	60.9%
Trade, Transportation, and Utilities	40.2%	59.8%
Natural Resources and Mining	44.7%	55.3%
Other Services	48.0%	52.0%
Leisure and Hospitality	52.5%	47.5%
Information	52.8%	47.2%
Professional and Business Services	53.3%	46.7%
Government	55.3%	44.7%
Construction	63.1%	36.9%
Manufacturing	79.6%	20.4%

Source: Census Bureau Pulse Survey

While rates of anxiety or depression declined steadily from 2020 through 2022 in Northern Virginia, Pulse Data indicate that the share of workers in the Commonwealth of Virginia suffering from anxiety or depression declined mildly from 2020 to 2021 before increasing from 2021 to 2022. Perhaps the most troublesome fact is that the share of workers with severe anxiety or depression in the Commonwealth remained flat at 14.9% from 2020 to 2021 and increased to 16.5% in 2022. These rates include Northern Virginia, where severe anxiety and depression declined over the period, suggesting that rates of severe anxiety and depression have increased notably in portions of Virginia outside the Northern Virginia region.

Figure 2. Share of Workers with Anxiety or Depression: Virginia



2.2 Economic Losses from Anxiety and Depression

2.2.1 Northern Virginia

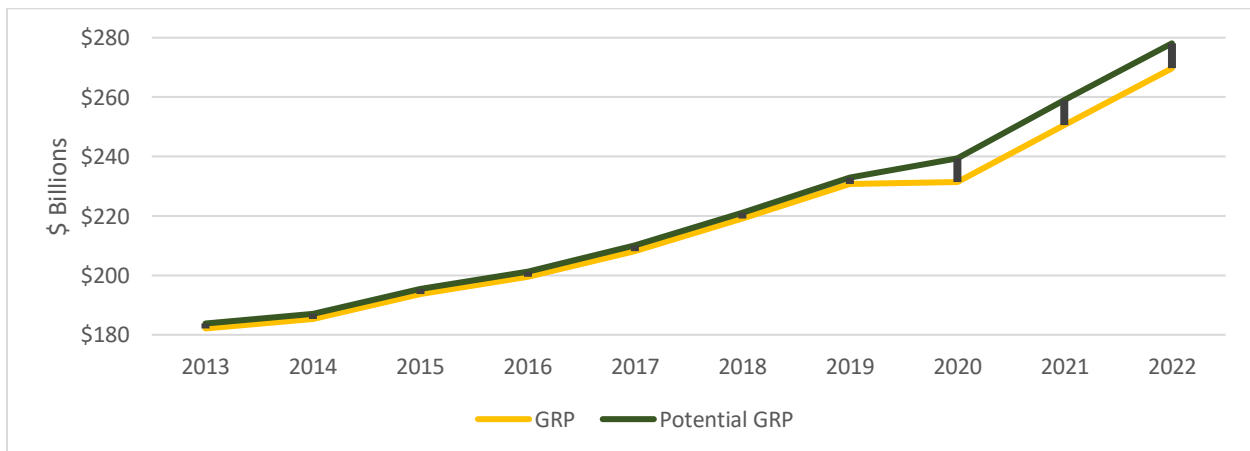
Estimated GRP losses for Northern Virginia are provided in Table 1. In 2019, it is estimated that Northern Virginia’s GRP was \$2.1 billion less (0.9%) than it could have been without absenteeism and presenteeism issues associated with mental health. After the outset of the pandemic, and a rise in mental health issues, GRP loss increased to \$8.0 billion, 3.4% of potential GRP. As rates of mental health issues somewhat subsided, so have GRP losses associated with mental health induced absenteeism and presenteeism. GRP losses declined to 3.2% in 2021 and 3.0% in 2022. Despite the percentage losses declining, the absolute losses continued to increase over this period.

Table 2. Estimated GRP Loss Due to Mental Health – Northern Virginia (Nominal \$)

Year	GRP (\$ Billions)	Potential GRP (\$ Billions)	GRP Loss (\$ Billions)	Potential GRP Percent Loss
2019	\$230.8	\$232.9	\$2.1	0.9%
2020	\$231.4	\$239.4	\$8.0	3.4%
2021	\$250.7	\$259.0	\$8.3	3.2%
2022	\$269.7	\$278.1	\$8.4	3.0%

To get a sense of losses in historical terms, the percent of potential GRP that was lost in 2019 is applied to GRP data from 2010 through 2019. In nominal terms, GRP in Northern Virginia increased from \$182.1 billion in 2010 to \$230.8 billion in 2019. Applying the potential GRP percent loss in 2019 to all years over the same period suggests losses increased from \$1.7 billion in 2010 to \$2.1 billion in 2019. However, potential GRP losses increased to \$8.0 billion in 2020 as the result of the dramatic increase in the share of the working population suffering from anxiety or depression.

Figure 3. Economic Output of Northern Virginia (Nominal \$)



2.2.2 Virginia

Annual GRP losses due to mental health issues for the Commonwealth of Virginia are provided in Table 2. In 2019, Virginia lost an estimated \$4.5 billion in output, 0.9% of potential GRP, due to absenteeism and presenteeism associated with mental health issues. As with Northern Virginia, the lost GRP increased sharply at the outset of the pandemic to \$18.1 billion (3.3%) in 2020, as a result of deteriorated mental health issues. In contrast to the continually declining percent of potential GRP loss in Northern Virginia, however, the GRP percent loss declined from 3.6% in 2020 to 3.4% in 2021 before increasing to 3.6% in 2022. The increase from 2021 to 2022 in the Commonwealth of Virginia was the result of the share of the workforce with mental health issues increasing, a phenomenon not recorded in Northern Virginia.

Table 3. Estimated GRP Loss Due to Mental Health – Virginia (Nominal \$)

Year	GRP (\$ Billions)	Potential GRP (\$ Billions)	GRP Loss (\$ Billions)	Potential GRP Percent Loss
2019	\$491.6	\$496.1	\$4.5	0.9%
2020	\$492.0	\$510.1	\$18.1	3.6%
2021	\$537.3	\$555.9	\$18.7	3.4%
2022	\$581.7	\$603.5	\$21.8	3.6%

To provide a sense of the impact of Northern Virginia on the Commonwealth’s economy, Northern Virginia’s share of Virginia’s GRP, Potential GRP, and GRP losses due to mental health are provided in Table 4. Northern Virginia accounted for 47.0% Virginia’s GRP in 2019 and 2020 before the share declined to 46.4% by 2022. In 2019, Northern Virginia accounted for 47.0% of Virginia’s lost GRP due to absenteeism and presenteeism resulting from mental health. After the initial spike in mental health issues associated with the pandemic, the share of workers with mental health issues in Northern Virginia declined from 2020 through 2022 while the share of workers with mental health issues in Virginia as a whole increased from 2021 to 2022. Given this, the share of lost GRP accounted for in Northern Virginia declined notably from 47.0% in 2019 to 38.6% in 2022.

Table 4. Share of Estimated Virginia GRP Loss Due to Mental Health Accounted for in Northern Virginia

Year	GRP	Potential GRP	GRP Loss
2019	47.0%	47.0%	47.0%
2020	47.0%	46.9%	44.3%
2021	46.7%	46.6%	44.5%
2022	46.4%	46.1%	38.6%

2.2.1 Northern Virginia Jurisdictions: 2022

GRP losses in 2022 for the 5 largest jurisdictions of Northern Virginia’s 18 total by GRP are provided in Table 5. The share of mental health problems for Northern Virginia is applied to all jurisdiction as Pulse Survey does not provide jurisdictional level estimates. As mental health issues in all jurisdictions are identical to the region’s, the percent GRP loss for all jurisdictions is the same as Northern Virginia in 2022 (3.0%). Fairfax County, the jurisdiction with the largest GRP (\$137.4 billion) had the largest GRP loss due to absenteeism and presenteeism resulting from mental health issues, \$4.2 billion. Arlington County and Loudoun County, the second and third largest jurisdictions by GRP lost approximately \$1.3 billion and \$1.0 billion, respectively, due to declining mental health. These five jurisdictions account for 88.7% of lost GRP of Northern Virginia and 34.2% of lost GRP in the Commonwealth of Virginia as a whole.

Table 5. Estimated 2022 GRP Loss Due to Mental Health: Ranked by GRP Loss (Nominal \$)

Jurisdiction	GRP (\$ Billions)	Potential GRP (\$ Billions)	GRP Loss (\$ Billions)	Potential GRP Percent Loss
Fairfax	\$133.3	\$137.4	\$4.2	3.0%
Arlington	\$40.8	\$42.0	\$1.3	3.0%
Loudoun	\$30.7	\$31.6	\$1.0	3.0%
Prince William	\$19.5	\$20.1	\$0.6	3.0%
Alexandria	\$15.0	\$15.4	\$0.5	3.0%
NoVa Total	\$269.7	\$278.1	\$8.4	3.0%

2.2.1 Northern Virginia Economic Sectors: 2022

Finally, Northern Virginia GRP losses in 2022 by economic sector are presented in table 5. The sector with the greatest GRP losses was the Professional and Business Services sector, which is estimated to have lost \$2.3 billion in GRP in 2022, or 2.7% of total potential GRP. The sector with the second largest loss was Trade, Transportation, and Utilities, which lost \$1.4 billion in 2022. The sectors with the largest losses are broadly reflective of the share of the region’s economy. Sectors with the highest percentage losses have higher rates of mental health issues. The sectors with the highest Potential GRP percent losses were Trade, Transportation, and Utilities (4.0%), Leisure and Hospitality (3.9%), Education and Health Services (3.8%) and Financial Activities (3.8%).

Table 6. Estimated 2022 GRP Loss Due to Mental Health: Ranked by GRP Loss (Nominal \$)

Super Sector	GRP (\$ Billions)	Potential GRP (\$ Billions)	GRP Loss (\$ Billions)	Potential GRP Percent Loss
Professional and Business Services	\$82.9	\$85.2	\$2.3	2.7%
Trade, Transportation, and Utilities	\$33.7	\$35.1	\$1.4	4.0%
Government	\$49.0	\$50.4	\$1.4	2.7%
Financial Activities	\$29.4	\$30.5	\$1.2	3.8%
Education and Health Services	\$17.7	\$18.3	\$0.7	3.8%
Information	\$21.2	\$21.7	\$0.5	2.4%
Leisure and Hospitality	\$10.0	\$10.4	\$0.4	3.9%
Construction	\$11.6	\$11.8	\$0.3	2.2%
Other Services	\$7.2	\$7.4	\$0.2	2.7%
Manufacturing	\$6.6	\$6.6	\$0.1	1.2%
Total	\$269.7	\$278.1	\$8.4	3.0%

3. Data

The data used for this report come from two primary sources: the US Census Bureau and Lightcast. Data from the US Census Bureau Pulse Survey provide estimates of mental health. The economic data comes from Lightcast, a private data provider. The Pulse survey is a weekly survey that began to determine the numerous impacts of the coronavirus pandemic on US households. The survey began April 23rd, 2020 and has since undergone a number of revisions, including three larger phases. At the time of this report’s writing, the current iteration of the report is phase 3.8. The survey is a 20-minute online survey emailed to households. Details regarding Pulse data selection are provided in the next section.

While early iterations of the Pulse survey included simple industry classifications, the survey was updated in week 49 (September 14th, 2022) to use the broadly accepted NAICS industry classification system. Unfortunately, notable shares of respondents did not complete the industry question, resulting in missing data for some NAICS categories. Given the missing data, responses are aggregated to BLS (Bureau of Labor Statistics) Super Sectors. Using the broader codes results in a single missing estimate, those with moderate anxiety/depression in the manufacturing super sector. As the manufacturing sector accounts for only a small share of the Northern Virginia economy, the missing data are unsurprising. Finally, as the Pulse Survey began after the onset of the pandemic, estimates for 2019 mental health issues in the region are taken from a Kaiser Family Foundation report.

Table 7. Share of Workers with Mental Health Issues by Severity and Industry

Sector	None	Mild	Moderate	Severe	Any Anxiety or Depression
Financial Activities	38.8%	17.4%	26.8%	17.0%	61.2%
Education and Health Services	39.1%	16.1%	27.5%	17.2%	60.9%
Trade, Transportation, and Utilities	40.2%	19.2%	21.9%	18.7%	59.8%
Natural Resources and Mining	44.7%	4.4%	38.8%	12.2%	55.3%
Other Services	48.0%	8.5%	33.1%	10.3%	52.0%
Leisure and Hospitality	52.5%	6.9%	15.3%	25.3%	47.5%
Information	52.8%	10.8%	28.2%	8.1%	47.2%
Professional and Business Services	53.3%	14.9%	22.1%	9.7%	46.7%
Government	55.3%	18.9%	16.3%	9.4%	44.7%
Construction	63.1%	5.1%	21.2%	10.6%	36.9%
Manufacturing	79.6%	0.0%	14.1%	6.3%	20.4%

Source: Census Bureau Pulse Survey

The second source of data is Lightcast, a private provider of economic data. Lightcast estimates data that are either suppressed or not estimated by public data providers such as the Bureau of Economic Analysis (BEA). Here, Gross Regional Product (GRP) estimates from Lightcast are used, as industry estimates from the BEA are suppressed. Lightcast estimates GRP using the income approach, which is the sum of earnings, profits, and taxes, minus subsidies. Earnings include industry wages, salaries as well as supplements and proprietor income. Profits are also referred to as “property income” or “non-labor income”. GRP is not adjusted for inflation (nominal dollars).

4. Method

The methodology used here has sought to balance precision with tractability. Overall, the methodology reweights GRP by estimated losses from absenteeism and presenteeism associated with mental health issues, as well as the share of workers suffering from mental health issues.

The first step here is the identification of losses associated with absenteeism and presenteeism at various levels of mental health severity. Absenteeism, when workers are absent completely from work, is scaled according to the level of mental health distress. Absenteeism is relatively easy to measure; it refers to the percentage of assigned work that workers with varying levels of mental health issues miss. Presenteeism, when workers are present but are not focused on their work and thus underperforming to some extent, is also scaled by the level of mental health distress.

Presenteeism is more difficult to measure, as the level of output that workers are failing to achieve is subjective and varies widely by occupation.

Estimates for absenteeism and presenteeism are taken from Beck et al. (2011) which uses PHQ-9 scores.^{iv} The estimates for absenteeism vary from no issues with mental health to severe mental health issues. In order to provide conservative estimates, the most severe category has been removed and the three categories of “mild” (PHQ-9 scores 7-9), “moderate” (PHQ-9 scores 10-14), and “major” (PHQ-9 scores 15-19) are used. The category “major” is referred to as severe in this report. Beck et al. present estimates for the total percent of time at work either missed (absenteeism) or impaired (presenteeism). Despite the total percent of time at work missed or impaired, presenteeism’s share of the total time missed or impaired is only reported for “mild” and the unused “severe” category, with other categories not reported. The shares of the unreported categories are estimated via linear interpolation and subtracted from the total to provide the estimates for the percent of working hours impacted by absenteeism or presenteeism. The share of a worker’s time is thus decomposed into the share of time absent, the share of time impacted by presenteeism, and the share of time with no issues (good days).

Following this step, several adjustments are then made to the share of each time.

First, while a worker’s time is impacted by presenteeism issues, we assume here that not all of the time is unproductive. To account for the fact that a worker may be mildly productive during times they are suffering from presenteeism, we adjust output losses using Work Output Scores (WOS) from Turpin et al (2004).^{v,vi} WOS are used to weight presenteeism, as WOS asks respondents to estimate the percent of their usual productivity that was lost due to health issues.^{vii} That is, WOS allows workers to subjectively assess how much less output they produced as compared to times when they are fully productive. In a region dominated by professional and business services, such adjustments appear necessary. Here, the share of time with no issues is also adjusted by WOS of those with excellent health, as reported by Turpin et al. This allows for workers with no mental health issues to also experience output losses related to presenteeism. Note that while the share of losses from this source appears large, it is because most of a worker’s time has no mental health issues. Excluding the adjustment to workers with no mental health issues, however, only marginally changes estimates.

Second, we assume that other team members can partially compensate for individual productivity losses. These estimates assume that co-workers can, for a short amount of time, increase their output to make up for some of the difference. Evidence from a Canadian study estimates that a 1% decline in attendance rate results in a 0.44% loss of productivity (Zhang et al, 2017)^{viii}. Thus, the share of time impacted by absenteeism and presenteeism is not assumed to be entirely translated into lost output, with output losses only equal to 44% of time impacted by absenteeism and presenteeism. Note that time impacted by absenteeism and presenteeism are both assumed to not entirely translate to lost output. The share of time impacted by absenteeism is thus adjusted to allow for co-workers to increase their productivity. The share of time impacted by presenteeism is adjusted both to account for some productivity from the worker as well as to allow for co-workers to increase their productivity.

Finally, the remainder of time is adjusted to account for some loss of output due to presenteeism issues. The losses from each are summed to provide an output loss per worker by mental health severity. The weights used to estimate GRP losses are provided in Table 8.

Table 8. Weights Used in GRP Loss Estimates

		<u>Anxiety/Depression</u>			
		None	Mild	Mod	Severe
Beck Et Al.	Percent of Time With Issue	8	29.6	38	46.9
	Absenteeism Share	0.6	4.0	7.6	12.5
	Absenteeism share (% of Total) (Linearly Interpolated)	7%	13.5%	20%	27%
	Presenteeism Share	7.4	25.6	30.4	34.4
Weights	Percent of Time With No Issue (= Days - % of Time With Issue)	92	70.4	62	53.1
	Productivity Loss on Present Days (WOS Turpin Et Al)	4%	15%	23%	44%
	Productivity Loss on Good Days (WOS Turpin Et Al)	4%	4%	4%	4%
	Output Loss for Absenteeism (Zhang et al.)	44%	44%	44%	44%
Calculate Output Loss from Each Source	Absent	0.2%	1.8%	3.4%	5.5%
	Present	0.1%	1.7%	3.1%	6.7%
	Time with No Issue	1.6%	1.2%	1.1%	0.9%
	Total Output Loss (%)	2.0%	4.7%	7.5%	13.1%

The second step is then to estimate GRP losses with absenteeism/presenteeism loss weights. GRP losses are estimated in a three-step process. First, GRP is allocated according to the share of workers reporting each level of mental health distress. Second, GRP is increased to the level of output that would be expected with *no* output loss from absenteeism or presenteeism. However, this step assumes that every worker is 100% productive. Third, the theoretically potential GRP from step two is reduced to the level of output for absenteeism and presenteeism levels of workers with no mental health issues. That is, the method simply works to estimate the level of output that workers would produce if those suffering from mental health issues had absenteeism and presenteeism levels of those without mental health issues. As a final minor adjustment, NoVa output totals are reweighted to match industry totals, as industry estimates provide slightly different totals for 2022. The Jurisdictions, and Virginia are adjusted using the same weight. The detailed methodology is reported in table 9

Table 9. GRP Loss Estimate Methodology

Step	Anxiety/Depression Level	Weights	2019*	2020	2021	2022
0. Share of Pulse Respondents	None		82.0%	43.4%	47.8%	48.3%
	Mild		11.0%	25.8%	23.2%	26.0%
	Moderate		4.0%	17.3%	15.1%	13.1%
	Severe		3.0%	13.5%	13.9%	12.7%
0. NoVa GRP (Billions)	Total		\$230.810	\$231.402	\$250.666	\$265.468
1. Share Out GRP by Anxiety/Depression	None		\$189.3	\$100.4	\$119.8	\$128.2
	Mild		\$25.4	\$59.8	\$58.2	\$68.9
	Moderate		\$9.2	\$40.0	\$37.8	\$34.8
	Severe		\$6.9	\$31.2	\$34.8	\$33.6
2. Output with No Absenteeism or Presenteeism	None	2.0%	\$193.1	\$102.5	\$122.3	\$130.8
	Mild	4.7%	\$26.6	\$62.7	\$61.1	\$72.3
	Moderate	7.5%	\$10.0	\$43.2	\$40.9	\$37.6
	Severe	13.1%	\$8.0	\$36.0	\$40.0	\$38.7
3. Output with Absenteeism and Presenteeism Levels of Workers with No Anxiety or Depression	None		\$189.3	\$100.4	\$119.8	\$128.2
	Mild		\$26.1	\$61.5	\$59.9	\$70.9
	Moderate		\$9.8	\$42.3	\$40.1	\$36.8
	Severe		\$7.8	\$35.2	\$39.2	\$37.9
Sum Output	Total		\$233.0	\$239.5	\$259.0	\$273.8
Weight by Industry Estimates	Industry Weighted Total	1.000173	\$232.9	\$239.4	\$259.0	\$273.7
	GRP Loss		\$2.1	\$8.0	\$8.3	\$8.4
	GRP Loss %		0.91%	3.35%	3.21%	3.02%

* 2019 mental health weights are from a Kaiser Family Foundation Survey, not the Census Pulse Survey.

5. Limitations

In general, the limitations of estimates produced in this report result from the measurement of lost productivity from absenteeism and presenteeism. Absenteeism is simpler to measure than presenteeism, as it is the percent of scheduled work that a worker was absent. Despite being simpler to measure than presenteeism, however, it remains difficult to attribute absenteeism to a particular issue. Studies working to determine the share of absenteeism resulting from mental health issues have to contend with numerous issues, such as recall bias, additional health issues, etc. The authors of the study used as the basis here acknowledge that their estimates may be high, as the sample was recruited from patients who had recently begun taking antidepressants and thus the sample may have higher rates of absenteeism than the general population with mental health issues. This is partially reasoning behind incorporating the WOS scores and the reweighted presenteeism.

Presenteeism has more limitations as it is difficult to measure from the outset. When workers are asked to recall what percent of their working time was impaired by anxiety or depression, the interpretation of any answer is difficult. For example, as in Beck et al, workers are asked on a scale of 1 to 10. The mean answer is 3.5, which is interpreted to mean that 35% of their time was impacted by presenteeism. However, as is assumed here, despite the fact that 35% of the time is impacted by presenteeism, the worker may still be producing, albeit at a lower rate. By assuming a productivity loss of 35%, the impact of presenteeism is equal to that of absenteeism. Beyond the measurement of presenteeism, for some tasks it is conceptually difficult to measure lost productivity. For example, the output of a worker expected to produce a set number of items, such as ball bearings or pupusas, per hour will be more easily quantified than a lawyer or analyst whose output is less tangible. The difficulty in measuring lost productivity is the reasoning behind weighting time impacted by presenteeism by Work Output Scores discussed in the methodology.

It is also difficult to estimate how *individual* changes in output impact team output, particularly when the cause of that lost productivity is related to absenteeism and presenteeism and when it occurs at scale (over half of the workforce in Northern Virginia is experiencing some level of anxiety and/or depression, which suggests that on average, half of the members of a team, business unit, or company are struggling, too). That is, how much work can be “shifted” to colleagues on days when a worker is either absent or has reduced output due to presenteeism. While a number of studies work to measure output losses associated with absenteeism, all acknowledge the difficulty in measuring the loss. A linked employee-employer study from Canada is used as the basis of this analysis.

In addition to the difficulties estimating lost output due to mental health is the simple fact that from 2019 to 2020, the region’s economy underwent perhaps the most significant change in the region’s history due to the Coronavirus pandemic. Disentangling the impacts of mental health from numerous other forces is difficult at best. Along with the rest of the nation, the region’s economy was simultaneously slowed by public policy in order to slow the spread of the virus and propped up through ultra-low interest rates stemming from the federal reserve. Additionally, the region experienced outmigration and a dramatic decline in labor force participation.

While the aforementioned limitations focus on those most relevant to the methodology used, additional limitations certainly apply. For example, additional costs to the economy (societal, quality of life, labor force participation, health care and insurance costs, etc.) are not considered. Due to the limitations, the analysis presented is intended to be transparent, and thus a tractable methodology was pursued.

References

- ⁱ Turpin, R. S., Ozminkowski, R. J., Sharda, C.E., Collins, J.J., Berger, M.L., Billotti, G.M., Baase, C.M., Olsen, M.J., Nicholson, S. (2004). Reliability and Validity of the Stanford Presenteeism Scale. *Journal of Occupational and Environmental Medicine*, 46(11), 1123–1133.
- ⁱⁱ As is reported in Beck et al, the percent of time impacted by presenteeism is assumed by entirely lost. This assumes that presenteeism is equivalent to absenteeism with the only difference being that the worker is at work. Here, we assume that the share of work impacted by presenteeism is still somewhat productive. Thus, the percent of time impacted by presenteeism is thus weighted by the percent of work lost.
- ⁱⁱⁱ Collins, J.J., Baase, C.M., Sharda, C.E., Ozminkowski, R. J., Nicholson, S., Billotti, G.M., Turpin, R. S., Olsen, M.J., Berger, M.L. (2005). The Assessment of Chronic Health Conditions on Work Performance, Absence, and Total Economic Impact for Employers. *Journal of Occupational and Environmental Medicine*, 47(6), 547–557.
- ^{iv} Beck, A., Crain, A.L., Solberg, L.I., Unutzer, J., Glasgow, R.E., Maciosek, M.V., Whitebird, R. (2011) Severity of Depression and Magnitude of Productivity Loss. *Annals of Family Medicine*. 9(4) 305-311.
- ^v Turpin, R. S., Ozminkowski, R. J., Sharda, C.E., Collins, J.J., Berger, M.L., Billotti, G.M., Baase, C.M., Olsen, M.J., Nicholson, S. (2004). Reliability and Validity of the Stanford Presenteeism Scale. *Journal of Occupational and Environmental Medicine*, 46(11), 1123–1133.
- ^{vi} As is reported in Beck et al, the percent of time impacted by presenteeism is assumed by entirely lost. This assumes that presenteeism is equivalent to absenteeism with the only difference being that the worker is at work. Here, we assume that the share of work impacted by presenteeism is still somewhat productive. Thus, the percent of time impacted by presenteeism is thus weighted by the percent of work lost.
- ^{vii} Collins, J.J., Baase, C.M., Sharda, C.E., Ozminkowski, R. J., Nicholson, S., Billotti, G.M., Turpin, R. S., Olsen, M.J., Berger, M.L. (2005). The Assessment of Chronic Health Conditions on Work Performance, Absence, and Total Economic Impact for Employers. *Journal of Occupational and Environmental Medicine*, 47(6), 547–557.
- ^{viii} Zhange, W., Sun, H., Woodcock, S., Anis, A.H. (2017). Valuing productivity loss due to absenteeism: firm-level evidence from a Canadian linked employer-employee survey. *Health Economics Review*, 7(3), 1–14.