

# Navigating Through a COVID-19 World: Avoiding Obstacles

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Individuals with balance and gait problems encounter additional challenges navigating this post-coronavirus disease-2019 (COVID-19) world. All but the best fitting facemasks partially obscure the lower visual field. Facemask use by individuals with balance and gait problems has the potential to further compromise walking safety. More broadly, as the world reopens for business, balance and gait testing in clinics and research laboratories will also be impacted by facemask use. Here, we highlight some of the challenges faced by patients, clinicians, and researchers as they return to “normal” after COVID-19.

**Video Abstract** is available for insights from the authors (see the Video, Supplemental Digital Content 1, available at: <http://links.lww.com/JNPT/A328>).

**Key words:** *balance, COVID-19, facemask, gait*

(*JNPT* 2021;45: 36–40)

Around the world, life for many people came to an abrupt halt with the onset of the coronavirus disease-2019 (COVID-19) pandemic. Nonessential businesses, schools/universities, and clinics closed, as hospitals prepared to deal with the rapidly spreading disease. As society emerges from social isolation, we encounter challenges navigating this strange new world. Physical therapists (PTs) must appreciate the impact that face coverings have on balance and walking for their clients. In the context of fall risk assessment, PTs must consider the potential impact of a face covering when interpreting examination findings. This will enable PTs to appropriately educate individuals regarding strategies for safe negotiation within the community while wearing a face covering.

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University of Rochester Medicine Otolaryngology donated masks in support of this project. The authors declare no other funding in support of this project.

The authors declare no conflict of interest.

Supplemental digital content is available for this article. Direct URL citation appears in the printed text and is provided in the HTML and PDF versions of this article on the journal's Web site ([www.jnpt.org](http://www.jnpt.org)).

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ISSN: 1557-0576/21/4501-0036

DOI: 10.1097/NPT.0000000000000338

Current Centers for Disease Control and Prevention recommendations include use of face coverings in public settings or when social distancing cannot be maintained.<sup>1</sup> Implementation of this guidance varies across states, but many businesses including hospitals and outpatient centers have implemented universal masking policies while indoors.<sup>2,3</sup> It is unclear how long the recommendations to wear a face covering will last, but important to recognize that there may be unintended negative consequences for many individuals with gait or balance difficulties. There is an obvious challenge to wearing facemasks noted by all individuals who wear glasses; visual acuity is impaired when glasses fog. A potentially greater challenge for individuals with gait and balance problems is the partially blocked lower visual field imposed by masks. Here, we highlight the implications of mask wearing on walking safety, clinical balance testing, and gait and balance research.

Vision plays an important role in walking, from balance<sup>4,5</sup> to navigation<sup>6</sup> and obstacle crossing.<sup>7,8</sup> In fact, the lower visual field is particularly important for obstacle avoidance and foot clearance.<sup>9,10</sup> Blocking the lower visual field leads to larger downward head tilt, shorter steps, and slower gait speed.<sup>9</sup> Downward head tilting will likely reduce the spatial “look ahead window” and negatively impact planned foot/limb trajectories.<sup>11</sup> Foot placement and toe clearance during obstacle crossing are also significantly impaired when the lower visual field is obscured.<sup>12,13</sup> These adverse gait characteristics only occur under more challenging gait conditions (obstacle negotiation, change in surface level) and are not observed during level overground walking.<sup>14</sup> Even healthy young adults walk slower and more cautiously when the lower visual field is blocked, especially when descending stairs.<sup>15</sup> For many healthy adults, these subtle gait changes may not significantly impact balance. However, for individuals with gait or balance impairments mask wearing will be more profound, potentially increasing fall risk.

Visual problems including loss of the lower visual field are associated with falls.<sup>16,17</sup> Older individuals wearing multifocal lenses are already known to have greater fall risk due to impaired depth perception and reduced contrast sensitivity.<sup>18,19</sup> It is unclear whether wearing a face covering presents an additional risk factor for these individuals. This question should be addressed once it is safe for research subjects to be tested without a face covering.

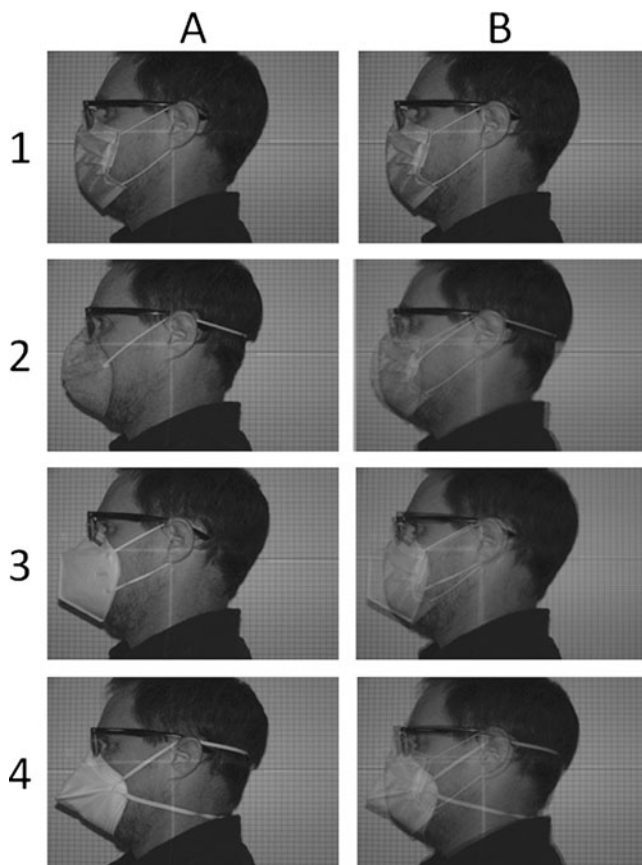
Common clinical tests used to examine walking balance often include visual obstacles or targets. The instructions for the Timed Up and Go include crossing a line marked on

the floor.<sup>20</sup> The Dynamic Gait Index and Functional Gait Assessment includes stepping over/around obstacles and negotiating stairs.<sup>21,22</sup> Although the implementation of those tests has not changed, scoring and interpretation may not be as straight forward when patients perform these tests while wearing a mask. Test development, validation, and score interpretation occurred using pre-COVID-19 cohorts, and those cohorts likely were not wearing facemasks. Therefore, clinicians now have the problem of test interpretation when gait speed and obstacle avoidance may be artificially impaired by wearing a mask.<sup>23</sup> If an individual slowed their gait and looked down to better view the obstacle because of the mask-imposed lower visual field restriction, how should they be scored? We do not recommend artificially inflating scores. Rather, we propose scoring based on actual performance instead of speculating that scores would be better without a mask. We also draw attention to interpretation of “borderline” scores and interpretation of elevated fall risk. Does the artificial testing environment (masking) sufficiently reflect the daily functional behavior and fall risk of the tested individual? We would argue that it does. In circumstances where masks are required indoors, such as grocery shopping, individuals may don their mask before getting out of the car. Thus, seeing the curb or potholes may be more challenging because of the mask while navigating across

the parking lot into the store. It is unreasonable (and potentially unsafe) to request patients remove their mask during balance and gait testing if facilities have universal masking policies. Further, testing “unmasked” may lead to unrecognized gait challenges during community ambulation potentially misclassifying an individual’s fall risk status.

As illustrated in Figure 1, some masks block the lower visual field more than others, but it is beyond the scope of this perspective article to identify an “optimal” face covering. Using a convenient sample case series, the images in Figures 2 to 4 highlight a substantial difference in visually detected proximity to an obstacle with face coverings donned compared with doffed. Importantly, we observed this regardless of the type of face covering. Each individual maintained gaze on a fixation point at their eye height to show the impact of their preferred face covering on peripheral vision. The difference in inches from where the obstacle on the ground was observable for each of the cases is presented in Table 1. A Research Review Analyst at the University of Pittsburgh Institutional Review Board (IRB) deemed our project “Not Research;” therefore IRB approval was not necessary.

Universal masking policies also present unique challenges for posture and gait researchers and clinicians who work with human subjects in balance rehabilitation. At present, the



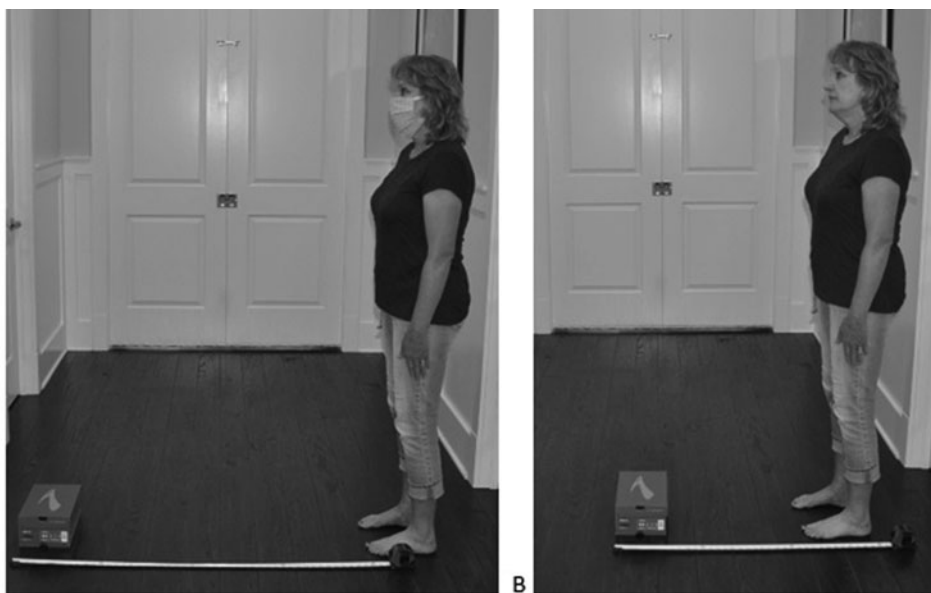
**Figure 1.** Column A, images showing 4 different types of masks: (1) surgical mask type 1, (2) surgical mask type 2, (3) K-N95 mask, and (4) N95 mask. Column B, the same images overlaid with image A1 to highlight how far each other mask protrudes forward away from the face, potentially further reducing the lower visual field.



**Figure 2.** A 72-year old man with (A) and without (B) bandana mask with forward gaze. First self-reported appearance of distal edge of box at 29.625 inches from tip of toes with bandana donned (A) and at 10.875 inches from tip of toes with bandana doffed (B).

“new normal” often requires people to wear masks when they are unable to socially distance or while indoors. For researchers in the field of balance and gait, this presents an interesting question. Does standing or walking balance while wearing a mask truly represent unmasked standing and walking balance? Arguably not, when the lower visual field is obscured.

Gaze affords the sensorimotor decisions that support successful gait performance to meet the varying demands of the natural world.<sup>11</sup> Restricted visual fields impair standing balance and obstacle clearance during gait.<sup>23-25</sup> Visually integrating lower limb position into estimated external space improves accuracy when clearing obstacles.<sup>12,26</sup> For researchers, the



**Figure 3.** A 67-year old woman with (A) and without (B) homemade mask with forward gaze. First self-reported appearance of distal edge of box at 44.125 inches from tip of toes with mask (A) and at 17.75 inches from tip of toes without mask (B).



**Figure 4.** A 50-year old man with (A) and without (B) N95 mask with forward gaze. First self-reported appearance of distal edge of box at 61.0625 inches from tip of toes with N95 mask donned (A) and at 24.75 inches from tip of toes with N95 mask doffed (B).

**Table 1. Distance (Inches) of Self-reported Appearance of Distal Edge of Shoe Box to the Tip of Toes While Looking at a Distant Visual Fixation Point at Eye Level (Not Visible in the Pictures)**

Subject	Personal Protective Face Coverage	Obstacle Proximity Distance, inches
72-year-old man	Bandana	29.625
Height = 71 inches	None	10.875
67-year old woman	Homemade mask	44.125
Height = 67 inches	None	17.75
50-year old man	N95	61.0625
Height = 73 inches	None	24.75

necessity of research subjects wearing a face covering while participating in research activities suggests important questions. Should mask-wearing research subjects be combined with existing datasets, or do they represent a distinct cohort? Should research or testing protocols that implicitly depend on fully available peripheral vision be revised to account for behavioral changes imposed by mask wearing? The answer to these and other more specific questions may differ depending on experimental procedures/protocols. We recommend that researchers use mask wearing as an unplanned covariate when adding to pre-COVID-19 datasets and openly report those unplanned analyses in the results.

Recognizing barriers to safe negotiation within the community is important for clinicians and researchers in the field of gait and posture. While wearing a face covering is important for health, it presents a unique challenge to individuals with balance and gait problems that may elevate an individual’s risk for falling. Being aware of this unique challenge will better prepare clinicians to educate their patients about walking safety.

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### Corrigendum

## Turning Towards Monitoring of Gaze Stability Exercises: The Utility of Wearable Sensors: Corrigendum

An acknowledgment of funding from the National Multiple Sclerosis Society was left off the article mentioned above. The correct funding information is stated below:

***This investigation was supported in part by grants from the National Multiple Sclerosis Society and the Foundation for Physical Therapy Research.***

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DOI: 10.1097/NPT.0000000000000340