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Research Article

COVID-19-Osteoarthritis Interactions, Predictions, and Mitigation: Can Blue Zone Findings Help? Overview and Commentary

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Abstract

The corona virus-19 [COVID-19], which unexpectedly heightened multiple health challenges among older adults beginning in December 2019, continues to influence many facets of elder health including having a possible role in exacerbating osteoarthritis linkages or a combination of linkages in 2023 and possibly beyond this period. At the same time, the recent 2050 osteoarthritis prevalence predictions that may well be underestimates imply that any effort to minimize osteoarthritis disability must be highly warranted in its own right, because osteoarthritis is a major risk factor for severe COVID-19 infections. Based on key 2022-2023 data base posting, a small body of current work strengthens a case in our view for more elucidation and interpretation of the clinical significance presently alluded to and to not overlook what has been learned about population wellbeing and healthy aging from both the COVID-19 pandemic as well as the health successes of Blue Zone locations.

Keywords: Blue Zones; COVID-19; Older Adults; Osteoarthritis; Prevention; Risk Factors

Introduction

A wealth of literature compiled since late 2019 shows that the novel and infectious corona virus termed SARS-2-COVID or COVID-19 that induces a severe form of respiratory distress [1] unexpectedly impacted the health of many citizens in all parts of the world, especially those in the higher age ranges with one or more health challenges. While less well publicized, there is substantive evidence of a parallel risk of developing or exacerbating one or more chronic health issues including possible drug use behaviors, loneliness and mental health symptoms [2] during- as well as after- resolution of an acute bout of COVID-19 disease. In addition to aging, correlates that appear noteworthy for both COVID-19 risk as well as one or more adverse COVID-19 outcomes, such as cardiovascular or metabolic diseases, and particularly obesity are indeed reported as being of high relevance in multiple publications to date [1,3-5]. However, while also associated in many cases with cardiovascular and obesity health conditions [6], the chronic health condition known as osteoarthritis, the most common form of adult arthritis, is surprisingly poorly documented among the major forms of post COVID disablement processes, now termed 'long COVID' disease. According to Sajjadi., *et al*. [7] while some discussions of osteoarthritis disability in the context of COVID-19 prevail, this line of inquiry is very limited to date despite the magnitude of the problem, but may reflect possible research disruptions due to COVID-19 or the view osteoarthritis is not an immune system linked form of arthritis, but a wear and tear disease of articular cartilage or a disease localized to the joint tissues affected symptomatically, rather than systemic or extra articular causes [8].

At the same time, despite the possible observed emergent clinical linkage between many features of the COVID-19 virus disease and osteoarthritis manifestations, and reports of breakthrough infections of vulnerable vaccinated adults [3], a coherent link that

may yet merge-was possibly not anticipated in December 2019, thus overlooked. Yet emergent data have shown COVID-19 may have a predilection for some osteoarthritis sufferers and may continue to do so, even after the acute infection is controlled. As well, some data may be misleading because cases with severe osteoarthritis awaiting elective surgery placed on waiting lists may possibly have been overlooked or dropped from active studies. In addition, potentially lethal COVID variants that have since emerged are hard to identify, cases with severe osteoarthritis that did not survive are not accounted for, and vaccine availability does not prevent all forms of COVID-19 infection. Vaccine resistance to these novel strains and vaccine challenges in heightening immunity in aging populations also remain in 2023. It also appears that the topic of COVID-19 and its possible osteoarthritis association is relatively unknown because this possible linkage is surprisingly not mentioned at the World Health Organization Osteoarthritis Information Site [10] as of September 2023, even though obesity alone-which is mentioned- can exacerbate both conditions.

Other related data collected since 1990 speak to an epidemic of immense proportion as regards older adults expected to present with symptomatic osteoarthritis in 2050 [9], and where the burden of the disease is reportedly projected to be immense [10-12]. Yet, as outlined by Sajjadi., *et al*. [7], while many other health areas have been explored since 2019, the extent of the COVID-19 pandemic's influence on osteoarthritis and any ongoing trials is currently unknown.

In this regard, this knowledge gap may prove highly injurious if one considers results of recent diverse population based surveys across 204 venues in the Burden of Disease Study that showed a tremendous increase in knee and hip osteoarthritis global prevalence from 1990-2020, and enormous projections exceeding one billion cases by 2050, not including other affected joints, such as the hand and ankle, and populations in countries where evidence based healthcare is not well developed [4,10,13].

Other data referring to biologic studies of cartilage in respect to osteoarthritis and that implicate biologic mechanisms that could be impactful in this regard [14] generally failed to discuss COVID-19 activation pathways of influence such as inflammation or mechanical loading pathways [14].

Given that osteoarthritis is currently deemed to be incurable, and progressive, as well as highly disabling and costly, and its key risk factors, while not usually inclusive of infectious agents, but rather point to a major aggravating role for obesity, and injury, this lack of possible important research must surely be of high concern in the face of global aging increments and longevity, alongside projected obesity as well as injury predictions common in older adult populations. Even in the absence of distinct research support and data, the projected social burden alone is potentially inestimable, given the overlapping influence of osteoarthritis on body pain, fatigue, depression, functional ability, and the risk for injurious falls. In addition, the incidence and prevalence of osteoarthritis can be projected to be heightened by exposure to COVID-19 disease directly as well as indirectly, while setting the stage for possible severe COVID-19 related illnesses [15]. In addition, the chronic persistence of intractable osteoarthritis and its limited intervention effectiveness that commonly fosters a reduced life quality, a loss of independence, sleep challenges and often excess pain necessitating a reliance on narcotics may also have inadvertently exacerbated any comorbid health condition, especially cardiovascular diseases linked to COVID-19 susceptibility.

These adverse aging correlates, may have arisen unexpectedly thus were not preventable to a high degree in the face of many restrictive pandemic mobility and service challenges and may well have been further compounded if the older adult with osteoarthritis was receiving helpful face to face treatments directed towards narcotic free pain relief and functional independence. They may have been further compounded because even when COVID-19 was at the height of its adverse impacts, very few studies were initiated to examine how COVID illness might impact osteoarthritis cartilage signaling pathways or any other disease correlate such as pain and inflammation, as the two health conditions might not have been viewed as having any major clinically relevant link [8]. Thus it seems safe to say the current future osteoarthritis disability projections may be lower than those published to date, and research gaps that continue to prevail in this regard do not bode well for various mitigation efforts such as the WHO's generic goal of Healthy Aging anytime soon [10]. As per the WHO [10], osteoarthritis can be experienced independently of COVID-19, but even if not pointed out, osteoarthritis can clearly be exaggerated or provoked in at least some post COVID-19 older adult survivors or those who

were not able to obtain timely health care services at the height of the pandemic. In this respect, Huang., *et al*. [16] found patients with osteoarthritis to be exposed to an increased risk of adverse outcomes of COVID-19, as well as possible disruptions in access to healthcare services and exercise facilities. This group has also revealed that there may be a significant positive genetic correlation between osteoarthritis susceptibility, COVID-19 susceptibility, and COVID-19 hospitalization. Moreover, this group identified a strong association between signal sites located near the *FYCO1* gene (lead SNPs: rs71325101 genes implicated in COVID-19 hospitalizations. Their findings further confirmed a link between osteoarthritis and COVID-19 severity, despite a non-causal impact of osteoarthritis on COVID-19 outcomes. Yet other data show joint diseases associated with COVID vaccines may arise even if the individual does not acquire COVID-19, and may replicate symptoms of arthritis such as joint swelling and pain [17]. In addition, Tuhanov., *et al*. [18] concluded that COVID-19 can affect the proteolysis-anti-proteolysis system even after a long post infectious state and may cause complications of existing musculoskeletal pathologies.

Another recent report suggests a possible osteoarthritis-COVID-19 link may prevail due to the potential role of pro-inflammatory cytokines and angiogenesis-related growth factors observed in both the pathogenesis of both joint pathologies as well as long-term systemic post-COVID-19 disorders [19] and after acute COVID-19 infections [20]. An innate as well as an adaptive immune response, similar to that detailed for obesity, diabetes, and cardiovascular disease may well preside in some osteoarthritis situations, and thus accounts for some of the currently observed long-term COVID-19 health impacts [21].

According to Zhang., *et al*. [22], even if the interactive nature of the Corona Virus Disease 2019 (COVID-19) and osteoarthritis is not well established to date, it appears safe to state these are both diseases that seriously affect the physical and mental health and life quality of patients, particularly elderly patients. In addition, even though the association between COVID-19 and osteoarthritis at the genetic level has not been investigated to any in depth degree to date, and thus evidence that may point to a common pathogenesis shared by osteoarthritis and COVID-19 cannot be verified, this group have identified 3 key genes known as, DDIT3, MAFF, and PNRC1, which are possibly involved in the development of both health conditions.

By applying molecular genetics and biochemistry methods, Huet., *et al*. [23] have shown the observed decrease of the *TGFB1* and *FOXO1* expression levels is more evident in the osteoarthritis patient after COVID-19 exposure, as was a more prominent decrease of *COMP* gene expression level. These data indicate more significant activation of cell destructive processes after the infection as well as further pathology progression. Emerging evidence points to the possibility of the emergence of a long COVID predisposition in cases with rheumatic diseases whose immune regulatory responses are impacted post-acute infection and severe health complications including organ and tissue damage [24]. Pain, fatigue, and neuropathy among other persistent myalgic signs may yet follow a COVID-19 episode and are comparable to common osteoarthritis manifestations in multiple respects [25].

Chen., *et al*. [26] note a growing body of evidence is showing that patients with osteoarthritis had a higher than anticipated COVID-19 infection rate and a poorer prognosis after any infection. Additionally, scientists have also discovered that COVID-19 infection might cause pathological changes in the musculoskeletal system, specifically hub genes that might overlap, and that may play a key tole in inflammatory osteoarthritis [27].

In short, in its own right, even if only a single joint is involved in the osteoarthritis disease cycle, the magnitude of the disability that may follow cannot be underestimated. In addition to inducing diverse degrees of functional limitation and disability, accounting for 2% of all years lived with disability worldwide, it takes a heavy toll on the lives of those affected, including hampering participation in daily activities and reducing quality of life. Nevertheless, outdated and dismissive narratives about osteoarthritis are pervasive, and it is a disease often considered inevitable, even if it only afflicts a modest percentage of aging adults. In addition, despite efforts to raise awareness that osteoarthritis is a serious disease, it often remains under diagnosed and undertreated, or the patient themselves fails to believe they have a role to play in protecting their joints and overall wellbeing. In addition to almost complete reliance on drugs and surgery and a medical model that focuses on pathology, Its research is commonly underfunded, or conducted on animal models or samples of induced osteoarthritis, and thus although immense projections of osteoarthritis disability have been put forth despite some concerted research efforts of note, these may not be sufficient to fully understand the disease

magnitude, and the need to address upstream factors in this regard to allay the costly impact the projected future burden. Almost no research on the possible mechanisms wherein an exacerbation of osteoarthritis and COVID-19 analogues has emerged, even though this could well reveal more sharply what is needed currently to avert 2050 predictions and why and how. Thus for those older at risk adults, as well as those affected with osteoarthritis, what is needed to allay their increased of subsequently developing a wide variety of other common conditions, including COVID-19 infections remains uncertain and largely unaddressed [28].

In this regard, we elected to examine the most recent available data concerning osteoarthritis disability

wherein of specific interest was whether:

- Available data support the need for more preventive goals.
- Public health strategies to raise immunity, reduce obesity, and injury and foster healthy aging are likely to prove more impactful than not.

In accord with da Rocha., *et al*. [29] this current overview is designed to highlight (a) the fact that COVID-19 can have a significant impact on osteoarthritis, the most common rheumatic disease; (b) osteoarthritis can raise the risk of an older person from acquiring COVID-19 infections; (c) possible unexamined linkages between these conditions at the molecular and genetic levels; (d) possible primary as well as tertiary prevention strategies based on Blue Zone data.

It was hypothesized that a linkage exists that determines the health outcomes of some older adults with osteoarthritis and COVID-19 exposures, and that a common population wide preventive approach might prove noteworthy in mitigation efforts against the debility incurred due to one or both of these conditions.

Methods

After searching the PUBMED, PubMed Central and Google Scholar databases to identify works published predominantly between January 1, 2022-September 20, 2023 items that discussed either some relevant potentially modifiable COVID-19 or osteoarthritis determinant, especially immunity, depression, and pain related to COVID-19 were downloaded and examined.

The search was limited however, by excluding preclinical studies, drug studies, surgical studies, samples younger than 65 years of age, and those that did not directly address the current topics. All forms of study were deemed acceptable if they appeared to address one or more items of specific present interest along with those examining aging successes in 'Blue Zone' venues and their possible determinants. After examining the data, a narrative overview of what emerged from the search was generated. Applications that could be harnessed towards fostering optimal health in the older years were specifically sought to address the current inequities in remedial or surgical realms between low and high income countries, and where those in low income locations tend to fare worse on all health indicators with few exceptions.

Results

Even if only considering 2023 published data in the present limited data base search, it is clear the many stand alone articles speak to the prevalence of disabling osteoarthritis in older populations and that despite years of research has not been amenable to any cure. Even more publications on COVID-19 and the older adult prevail even though this virus is now said to have mutated into less lethal forms as of 2023. Much fewer articles are posted examine both these conditions simultaneously or prospectively, suggesting they were not viewed to have any interactive relevance at the outset of the COVID-19 pandemic.

Hunter., *et al*. [30] recount that an enormous increase in osteoarthritis prevalence was evident between 1990-2019 that is likely to be compounded by the combination of aging and the problem of obesity, and that the condition remains a potent marker of disability, especially in less affluent nations. However, even though the disease has multiple personal, economic, and societal implications, osteoarthritis is relatively neglected both in the clinical as well as the research contexts if compared to the attention given to heart disease, diabetes, and mental health problems that can all prevail in association with osteoarthritis. In addition to evidence that patients with osteoarthritis have reported practitioners may downplay their health concerns this trend appears to have ensued beyond 2019.

As borne out by a former Global Burden of Disease study published in 2023 [9] there were an estimated 303.1 million prevalent cases of hip and knee osteoarthritis worldwide in 2017,

plus almost 10 million adults years living with disability due to hip and knee osteoarthritis [10] and who reported a poor life quality. These current data that speak to an ever increasing upward trend in osteoarthritis among older populations do not however factor in COVID-19 ramifications for their projections, hence may prove to be underestimates of what populations can expect if trends continue [31]. Moreover, even if these data are sufficiently robust, the study failed to include many forms of osteoarthritis that prevail, as well as possible populations or practitioners that do not follow western medical model practices, subjects who were not included due to lockdowns and excess anxiety or depression, those who did not meet study criteria, or were excluded from the study population for technical reasons, and hence were not included in the analyses. The estimated economic consequences of osteoarthritis put forth as attributable to the disease, including treatment costs, and loss of productivity may also prove to be inaccurate, if for example mental health consequences and depression [32], problems with opioid addiction, and others are not accurately factored in [30,33]. The added burden attributable to oftentimes fragmented, or misinformed public health mitigation strategies against COVID-19 since 2019, plus the current lack of a universally efficacious vaccine to counter COVID-19, plus enormous health equity issues that can drive exposure to the virus as well as osteoarthritis progression such as pollution, vitamin D deficiencies, and falls associated injuries are clearly crucial to address [34].

In the interim, current data show that despite multiple gaps and unknowns in this realm, this topic of COVID-19 and projected osteoarthritis disability increases among older adults are possible topics of high relevance to the rheumatology and general medical practitioner and policy maker concerned with aging populations' wellbeing in that that the older adult with one or more joints affected by osteoarthritis appeared to be more likely to be at higher COVID-19 risk, especially if their disease was categorized as severe. Those survivors of COVID-19 returning home may also develop excess muscle pain that can foster muscle and joint aging [35] and is hard to reverse especially if affected adults are forced to follow a pattern of increasingly sedentary rather than active living activities that foster health, as well as anxiety and depression symptoms [32], which are predictors in their own right of both physical and psychological declines, as well as long-term physical disability, and severe dependency, plus possible risk for secondary COVID-19 infections or a more severe form of this condition. Moreover, Atkins., *et al*. [36] found older depressed adults to not only exhibit associated COVID-19 infections requiring hospitalization, but many had experienced one or more falls or fragility fractures that could worsen their prognosis for osteoarthritis as well as secondary infections immensely and significantly. As well, older adults with osteoarthritis hospitalized for COVID-19 were found to not only experience depression, but reported declines in sleep quality, well-being and cognitive functioning, plus a sense of a heightened pain levels that required increased analgesic use [37]. Having a decreased social life and fewer in-person social interactions as a result of the pandemic, plus ensuing and unrelenting difficulties in accessing needed or regular health and social services as well as COVID-19 information [38-40] may also have increased the use of addictive pain medications and their oftentimes negative interactions.

At the same time, non operative care may have remained limited, or was only offered via technology that might be too challenging for an older adult to navigate and follow. Home visits to assure safety, for example against fall, may have been curtailed as well, those sustaining fractures may continue to have longer than desirable lies, and a lack of income or food access as well as social isolation may have worsened the older adults overall health profile, and possible osteoarthritis severity or susceptibility.

Consequently, although current literature is replete with reports detailing novel stem cell approaches, artificial intelligent robotic surgery, and biologic efforts to regenerate articular cartilage and reverse osteoarthritis, how to prevent the condition from escalating, especially in the less developed world, where the issue of health inequity is pervasive and unjustified is clearly a complex albeit pressing issue. These older adults, many of whom live in poverty, are undoubtedly extremely vulnerable to multiple disease factors including lethal infections, injuries, obesity, frailty, and multiple stresses and stressors, especially if they are prone or have osteoarthritis [41] and need to be proactively protected against excess socially determined adverse health factors and excess suffering in the future.

At the same time, since there are countries or geographic locations across the globe where the majority of older adults appear to age gracefully and longevity rates are consistently high, even if they do not resemble advanced economies, it appears that

their experiences and modes of cultural organization may be reproducible as well as cost effective and emulating- on a broad societal scale, in efforts to mitigate the untold projected future suffering of many older adults as well fostering an opportunity to save diminishing health care resources. Fan., *et al*. [3] further stress the importance of more proactive health management of patients with obesity and metabolic abnormalities in efforts to reduce the incidence of severe COVID-19 after vaccination. Undoubtedly they do this to address the independent impact of obesity and metabolic abnormalities on the incidence of acquiring severe COVID-19, plus excess pain of one or more affected joints regardless of direct COVID-19 exposure [42-45], and even after vaccination [6].

The dilemma remains however, as to how to avert or mitigate or reduce the projected osteoarthritis disability rates and the immense related burden predicted by 2050 such that the quality of daily life and aspirations of all forthcoming older adult populations can be maximized as proposed by WHO [46]. Hypothetically, this future predicted epidemic and others may be advanced by timely and comprehensively delivered sustainable population wide efforts to address potentially modifiable issues that can impact immunity, and cell biology as well as longevity and health status in multiple ways [47]. In this respect, efforts to encourage basic moderate physical activity participation and sound nutrition practices appear highly promising, and may greatly impact projected joint reconstruction needs and costs, care deterioration due to excess health system demands, excess suffering and possible increased wait times [44] and suboptimal knee surgery outcomes [45], among many other benefits, such as a reduced risk of COVID-19 associated infections and premature death or debility due to long COVID manifestations.

While numerous public or population health directives prevail, and a myriad of extrinsic intervention options prevail, those extracted from Blue Zone research observations and efforts to account for the overall successful aging of older adults in these locations appear very promising-notwithstanding the many social impediments to their attainment in many countries without a concerted political as well as individual and community will. Their successes in the health sphere that might impact osteoarthritis as well as COVID-19 risk factors, onset, progression, and severity, plus obesity, being sedentary and incurring injury as highlighted in the literature include:

- Opportunities for all citizens to move purposely and be active, in a pollution free environment, for example by doing more walking, food preparation, or gardening or outdoor recreational activities [48-50].
- Exposure to a peaceful close knot environment, small plant based meals, vegetarian diets, and dietary practices [51-53].
- The presencsocieities, these are not always adhered to even if social factors are favorable. e of strong family ties, generational, and social support [54].
- Having a sens in western se of purpose/tradition/community/continuity [55].
- Having opportunities for service and altruism [55,56].

Avoidance of risky behaviors and toxins, processed foods and sweetened beverages, repetitive movements, excess social media and electronic device usage, having access to clean drinking water, sunlight or vitamin D supplementation, and the ability to pursue sleep routines that refresh and are safe from adverse extrinsic forces, are strongly indicated as well.

Unsurprisingly, although exercise and diet are well established longevity and health affirming recommendations in most western public health and medical oriented spheres, these are poorly adhered to in general, even if social factors are favorable. Yet, when analyzed, body systems that are often compromised in the West, appear favorably impacted by Blue Zone lifestyle practices and behaviors, including those of the immune and cardiovascular systems [55,57]. As well, data support the idea that placing the onus for curating a healthy environment solely on the individual does not work as well as through supportive policy and environmental changes to support behavior changes [58] known to foster life quality and expectancy, reduce obesity and poor overall physical and mental health. Also prevalent in Blue Zones, but often lacking in the West, non genetic factors such as the presence of consistently supportive social and emotional interactions can prove beneficial as well [53,58] and appear to have a clinically relevant influence on elements of vascular physiology, and hence possibly on COVID morbidity [54]. Messenger RNA activity implicated in age associated diseases may also be favored by the adoption of a vegetarian diet [51], as may many other pathways, including oxidative pathways and the immune system [55].

As recounted by Nestle [59] the Blue Zones approach has thus been enacted in the United States and the project is one thatembraces the idea of cities applying multiple interventions based on observations of healthful practices common to long-lived population groups in places like Okinawa, Japan; Sardinia, Italy; and Loma Linda, California. Since 2012, Blue Zone strategists have engaged with city planners in several Southern California coastal towns to establish smoking bans, make streets walkable and bike friendly, increase access to healthier food in restaurants, establish education programs in grocery stores, and promote social support for these efforts. The project reports significantly reduced obesity and cardiovascular risk factors among people in the intervention cities compared with those in California as a whole. Bays., *et al*. [49] note that cardiometabolic health in particular is evident in the context of those Blue Zones where locally produced plant based diets prevail [49].

Discussion

One of the most pervasive problematic health issues facing older adults is the fact they are often highly prone to joint dysfunction, as well as chronic pain, obesity, cardiovascular problems, falls and falls injuries, and related stresses that can lower immunity and render them susceptible to COVID-19 viral infections and others. Accordingly, keeping the older adult as healthy as possible has been deemed to be one of the most important public health issues in today's aging society, regardless of country or locality. However, although much research in this regard has been forthcoming, very few public health organizations appear to be in a position to focus their resources in a population based mode to maximize wellbeing uniformly and equitably, and very few not only failed to clearly anticipate the onset of the COVID-19 and its immense impact on older adult populations, but its persistent influence on the wellbeing of older adults in particular. In keeping with the idea of the concept of 'health for all' [46], and that there are clearly multiple modifiable factors that can potentially offset the multiple apparent negative outcomes of COVID-19 as well as osteoarthritis attempts to harness programs directed towards encouraging one or more of these potentially reversible attributes, such as obesity, may have a profound personal, household, and community wide as well as multiple economic impacts [30,41,62]. As such, it is conceivable that Blue Zone lessons from the world's longest lived adults including those with osteoarthritis may yield multiple emotional as well as physical health benefits that are associated with both protecting against excess COVID-19 and osteoarthritis risk and debility. While much remains to be examined and uncovered as well as implemented in this regard, persistent as well as emergent issues associated with COVID-19 as well as osteoarthritis, potentially render the need for multilayered swift actions sooner rather than later, especially upstream programmatic approaches in almost all non Blue Zones, especially where crucial services are back logged or have been discontinued or rendered obsolete. As mentioned, despite the importance of counseling, having timely appropriate diagnostic opportunities, exercise and nutrition opportunities, all these health attributes may have been disadvantaged to a high degree following COVID-19 onset and are now potentially hard to reverse in a frail elder or an elderly economically disadvantaged person in poor health.

Indeed, the highly deleterious observed linkages between stress, fear, anxiety, declines in overall wellbeing, social isolation, possible falls and depression risk/exacerbation, amidst the COVID-19 pandemic could arguably have been largely prevented, as could the excess osteoarthritis disease burden attributable to the COVID-19 illness process indirectly.

In addition, even though progress has been made in combating COVID-19, and restoring services, when seen against the backdrop of a pending osteoarthritis epidemic alongside the persistent obesity epidemic it appears that a failure to implement timely mitigation public health programs in this regard alone will prove enormously costly. Due to the inability of any country to address the actual needs of the older adult in this respect, it is possible some Blue Zones lessons from the world's longest lived adults can however, be of some help in countering this aforementioned projected global disability trend projections.

In addition, as discussed by Quash., *et al*. [60] it appears especially important in this regard to focus on efforts to combat social isolation, and its correlation with depression, and poor health status and thus a reliance on telemedicine [40] should be discouraged in our view. At the same time, rather than waiting for the tide to turn, media and public health advocates are urged to devise simple health promotion messages to apprise the public of the importance of fostering optimal health practices that can secure a healthy lifestyle for all not only during pandemic times but later on in life

By contrast, a failure to provide a clear understanding of the possible linkages between behaviors and COVID-19 among older adults, especially those with severe painful disabling osteoarthritis, and where a falls injury case may actually be a sign of an acute COVID-19 reaction in an older adult [61], a failure to address one or more of these overlapping emergent issues may predictably result in immense excess personal as well as societal costs alongside increases in hospitalization rates and health provider burnout and burden. However, by starting to simply target younger as well as older adults and their families to examine Blue Zone social behavior attributes, including those who have suffered from COVID-19 as well those suffering from multiple comorbid health conditions, and contacting them to provide any necessary resources to offset disability and illness risk, as well obesity and depression risk are paramount in this regard.

Adults living in the community who might benefit most are those-

- With mobility problems
- With one or more co-morbid health challenges
- Who live alone/or are socially isolated
- Who are depressed or anxious
- Who are weak and frail
- Those who are food insecure
- Those who are homeless or have no provider
- With intractable pain [62]

In essence, potential outcomes of a well constructed far reaching policy and prevention effort, albeit possibly only able to produce modest benefits may have widespread favorable personal and societal health ramifications for years to come, including, lower COVID-19 infection risks and rates along with osteoarthritis disability rates, immense suffering, and lower life quality and reduced survival rates. To this end and in the context of an increasingly globalized planet health policy makers and practitioners might look to improving the health for all not only those in the area deemed to be Blue Zones.

Limitations to the above discourse are its focus on 2022-2023 publications, the use of a limited set of data sources, the quality of the reports that was not assessed, and the fact the data do not focus on a broad enough spectrum of adults and disease subsets and preventive as well as intervention strategies other than a conceptual population wide preventive approach. Supplementary approaches such as counseling, nutriceutical usage, and health literacy issues are not examined or discussed.

No data on osteoarthritis and its presence or trajectory or presence in Blue Zones was found and may indicate a realm for future topical investigations.

Conclusions

While this current overview is largely conjectural, it appears to place emphasis on and support several key facts:

- COVID-19 and osteoarthritis in the older population remain serious seemingly intractable health problems for many older adults, especially if older adults are deemed to be in poor health, obese and/or live alone with limited resources.
- There may be important biological interactions between the presence of these conditions that affects older adults health status adversely that warrants exploration.
- Implementing a population wide generic model of strategies extracted from Blue Zone life successes may help to foster a health aging state including immune health, while minimizing or compressing the intensity and duration of years of distress and debility among many older community dwelling adults no matter where they reside.
- While much is currently being written about the impact of COVID-19 on mortality rates among older individuals, and osteoarthritis a major crippler of older adults is expected to rise rapidly in prevalence by 2050, efforts to carefully examine the currently observed associated of COVID-19 and osteoarthritis, which is relatively neglected, holds promise for both the researcher as well as the practitioner and policy maker.
- More intense research of large diverse samples in low and high income countries and the degree to which Blue Zone lifestyles appear favorable across the lifespan also warrants insightful study.

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Conflicts of Interest

None.

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