

Obesity and Falls Incidents among Elderly Community Dwellers: Umbrella Review of Salient Peer Reviewed Research Observations and Emergency Services Intervention Implications

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Abstract

Obesity prevalence, increasing rapidly among older populations has many health implications including disabling falls associated orthopedic consequences. This brief specifically examines whether obese adults are at increased risk for injurious falls and possible bone fractures requiring timely and insightful emergency services responses and salient secondary falls prevention directives, and if so, what preventive approaches other than medication would be recommended to avert one or more future injurious falls in those with concomitant type 2 diabetes and/or osteosarcopenia. It also examines if a fall can engender a heightened obese state in its own right and a possible associated link to further osteosarcopenia, a debilitating aging condition. Based on relevant literature located in key databases and published predominantly in the time periods 2010-2026 using the search terms: emergency medicine, falls, obesity, fractures, and intervention among others, data revealed: 1) A possible increased risk of falling and fracturing a bone in older obese adults. 2) Most falls determinants identified in this regard are preventable. 3) Falls may pose a possible unrecognized risk factor for bone fractures in the face of type 2 diabetes/osteosarcopenic obesity or its exacerbation. 4) Minimizing excess body weight, controlling any tendency to adopt a sedentary lifestyle, as well as advocating for vitamin D supplements where indicated will likely reduce overall health costs and suffering attributable to injurious falls as well as recurrent falls among the older obese population especially if thoughtfully delivered by first responders and attending emergency medicine personnel.

Keywords: Aging, Emergency Medicine, Falls, Fractures, Obesity, Prevention, Osteosarcopenic Obesity, Type 2 Diabetes

1. Introduction

It appears beyond dispute that falls defined as a loss of balance from a stable state due to one or more often unanticipated or unrecognized extrinsic or intrinsic factors, or as a result of tripping or a slip incident occur readily and with innumerable severe consequences in the older population. Inducing highly adverse late life impacts and unwanted potentially highly injurious bone fractures, falls may impact as well as engender one or more physical, anthropometric, social, multisensory, psychological, mobility and functional challenges and impairments that rarely diminish without due consideration [1-3]. At the same time, inattention to the degree to which obesity - an immense escalating global health concern and one that can affect bone and muscle structure as well as gait and health status, including the onset and perpetuation of type 2 diabetes and osteosarcopenia [age associated bone and muscle mass losses] – can collectively

heighten secondary falls and fracture risks, other fall related injuries, as well as post fracture treatment outcomes regardless of its anabolic impact on bone mineral density [2-10]. Indeed in the face of either a single or recurrent falls events sustained by the older obese type 2 diabetic adult this may necessitate the use of many costly health resources, including the risk of an increasing need for multiple medications as the years unfold, and possible institutionalization and premature mortality, no matter where the older adult resides. At the same time, this scenario is juxtaposed by the lack of effective falls prevention efforts, the possible failure to administer bone building protective drugs and therapy to the obese aging adult, a belief the obese incur better bone protection than the non-obese, alongside increasingly vocal demands by aging adults for more autonomy as well as efficacious efforts to extend their years of healthy life as well as efforts to improve or maximize their life quality [2,10]. However, in a society with high

numbers of aging overweight adults, simply failing to address the ramifications of obesity such as bone fractures may predictably induce many costly degrading health situations that could be prevented, for example in the case of an older overweight faller the first responder may provide information that turns out to be highly effective in minimizing future personal and societal costs, including excess premature morbidity and mortality costs [1,2].

Unfortunately, not only does the ability to effectively reduce the persistently high prevalence of falls among the elderly as a vulnerable population remain limited, but many misconceptions prevail about the role of obesity in mediating falls as well as fractures in the obese adult despite many years of dedicated efforts aimed at uncovering their underpinnings and some robust insights that can be harnessed to guide, direct, and implement related falls prevention goals [10-15].

However, even though a steady inventory of identified remediable or changeable risk factors for falls in the older adult population as well as in the case of an obese state of being where osteosarcopenic obesity embodying muscle as well as bone mass declines and related fat mass increases and deposition is rife, the lack of motivation to develop one or more sound non pharmacologic solutions for mitigating many high age health challenges as well as falls, and environmentally derived obesity underpinnings, largely remain. In particular, the idea that certain behaviors and beliefs, as well as biomechanical factors rather than body weight alone can interact to heighten late life falls risk, and in a sizeable number of overweight older adults, if not all, their likely increased fracture risk, constitutes limited attention at best [2,10]. Hence, what could be done in this regard is rarely contemplated, translated, initiated or enacted effectively at either the secondary or tertiary prevention levels clinically speaking. For example, in addition to possible misuse of single and especially multiple medications, including their under or over usage, the deterministic proven role of physical inactivity, knee extensor muscle quality, poor diet, deficient postural control, cognitive and sleep problems, low self-efficacy beliefs and an inactivity related decline in fat free muscle mass and bone are rarely embraced in mainstream medicine realms or in an inclusive or holistic long term continuous manner despite almost 20 years of acquired related understandings [13].

Obesity as well as its possible 'hidden' ongoing emergent osteosarcopenic status, a common largely age associated chronic health condition, and one occurring frequently today among the older adult population is however likely to continue affecting millions of this growing cohort globally and incrementally as well as severely by inducing an exaggerated risk of bone fragility, recurrent poorly treated or understood falls- fractures and falls mediated injuries, muscle mass losses and their impacts on mobility that may exceed those with a healthy weight status even if not fully supported by all [1,3,6,10,14-19]. Added to this, may be longer lies after a fall, extensive soft tissue damage, pain, and a host of progressive health problems, including possible excess diabetes and sarcopenia and/or sarcopenic obesity muscle mass declines as well as a deficient motivation to move that does not

occur to the same degree in the healthy weight older adult [4].

At the same time, those subjected to recurrent falls or injuries may experience a variety of cumulative disabling psychological and social impairments that ultimately heighten the chances of a severe disabling life trajectory and outcome especially if they sustain one or more bone fractures. Indeed, sufficient data reveal, it is not uncommon to observe those older adults who have fallen once or repeatedly, may not go on to develop excessive reactive fears of future falls or pervasive immobilizing falls concerns termed kinesiphobia, known to be especially harmful to the cardiovascular and musculoskeletal systems of the aging adult, but the likelihood of increases in fat mass as well as bone fragility.

In many obese older adults, even if excess bone fat is deemed protective against fractures alongside a heightened bone mineral density presence it is also highly probable the event of an injurious fall in those diagnosed as having comorbid type 2 diabetic cases may also encounter falls quite readily if on insulin, as well as having slower healing and surgical recovery rates, as well as possible functional loss increases, especially in the case of those who adopt sedentary fear evoked behaviors and/or exhibit poor proprioception, impaired dynamic postural control, gait, and stability responses, plus diverse nutrient deficits [5,10,20-22].

There is in fact no argument that this cycle of cascading events is a highly probable one and one likely to be extremely challenging to reverse or mitigate successfully in the absence of periodic assessments, early efforts to advance bone and overall health, and the implementation of cross cutting related interventions that can advance rather than impede the subject's actual or more underlying obesity associated condition[s] as well as their perceived overall wellbeing and day to day self-care abilities, plus their ability to function independently, safely, confidently, and socially without a fear of falling due to one or more obesity related health factors [20-24].

In this regard, while most researchers favor exercise as an adjunct to sound nutrition practices and glycolic control where indicated so as to limit the multiple probable dysmobility impacts of falling, most work in the past has placed little importance on the emerging role of physical activity as an obesity deterrent in the older adult population with a high falls propensity, rather it has relied on pharmacologic strategies that may in fact encourage osteosarcopenia - a possible parallel and powerful falls injury mediator alongside possible diverse aging, type 2 diabetes and obesity correlates such as neuromotor forms of dysfunction, deficiencies in balance, depression and falling fears that may affect many life affirming functions and body systems as well as multiple functional attributes such as muscle fiber type losses, strength and bone health declines, balance control confidence declines, and subnormal gait biomechanics [20].

2. Problem Statement

Although falls injuries clearly pose a major threat to an older person's life quality, most articles on obesity and its ramifications

in later life do not focus on this topic from the viewpoint of bone though emerging evidence has suggested this may be of high relevance to many individuals as well as society. In particular, exposing aging adults with a high body fat status to falls prevention plans but that neglect the importance of periodic related screenings for any physiological changes that can yet heighten falls risk, such as increasing gait challenges, and one strongly indicated, is not commonly enacted [25-30]. However, as the research evolves, it is apparent a potentially key mediating or explanatory link to muscle and bone mass that is exposed to fat infiltration is a key target to mitigate or prevent in all likelihood as is excessive bodyweight associated reductions in the ability to easily perform daily-life activities without excessive increases in postural sway conditions that may be linked to falls [26].

3. Rationale

Falls represent one of the most common potentially preventable geriatric syndromes encountered in primary care settings and others and thereby impose a growing incalculable burden on many aging individuals, their families, and healthcare systems often inadvertently. This situation is compounded in those with concomitant type 2 diabetes and osteosarcopenia, even though this may not be recognized or inevitable, but rather measurable and largely preventable [25-35]. However, this cycle of events is commonly ignored until it is pressing, or undertreated or treated non-holistically or only in one spheres not others. Indeed, from the multi factorial nature of falls in the elderly, it appears most of their specific causes can be traced to one or more health behaviors including some that provoke obesity and chronic conditions such as type 2 diabetes, plus its neuromuscular associations, as well as the impact of polypharmacy status that can reduce bone quality and heighten fracture risk, alongside various nutrition factors that can possibly be mitigated or managed more effectively, for example eating low glycemic content foods and those rich in vitamin D and calcium. While preventing obesity in the first place is the most obvious solution here, recommended approaches are often ignored, incorrect misconceptions may drive health decisions, and may thereby exacerbate rather than attenuate any excess weight associated falls risks [36-45]. Those older adults who fall and require immediate emergency responses may however be well-served by one or more of these important health providers in our view.

4. Review Aim

To examine and elucidate upon what appears to have emerged as regards the specific risk factors occurring in the older obese adult over time as this may impact bone fractures and falls injury risks, especially in the realm of a possible interactive impact of excess fat mass on muscle and bone health. In particular, based on an understanding of the risk factors for falling in general, plus those that are specific to those with obesity, we sought to identify how providers in emergency settings can direct their clients so as to help them to avert or reduce future falls and falls injuries, especially one or more bone fractures in this growing population.

5. Hypothesis

Untreated obese older adult fallers whose bone and muscle mass deteriorates unduly are especially likely to go on to incur one or more injurious falls fragility fractures if they fall repeatedly after an initial fall and that pose an immense personal degree of suffering alongside immense public health costs in all aging societies especially among those who survive.

6. Methodology and Approach

To gain some perspective on the state of knowledge and its application in this regard and to establish if more can be done to reduce the burden of falls injuries among older adults suffering from excess fat distributions and diagnosed as having an obese profile with or without type 2 diabetes, if anything, we conducted a comprehensive albeit selective umbrella review of related articles housed in the PUBMED CENTRAL, GOOGLE SCHOLAR, and PUBMED computerized databases over an extended time frame of 20-25 years using the key words: emergency medicine, falls, older adults, obesity, falls, prevention, sarcopenia, and type 2 diabetes. In terms of the data collected, only those sources related to obese community-dwelling elders were considered. Excluded were studies that took place in hospitals other than in emergency rooms, nursing homes or those that discussed pharmacologic management approaches, or genetic and biochemical mechanisms of pathology and intervention implications. Data were summarized solely in a narrative format.

7. Overview of Findings

The aforementioned extensive search, while not necessarily inclusive of all related data sources and perspectives, revealed a considerable number of related papers over the years that not only describe falls in older adults, but more specifically their underlying causes. A high number now detail a specific role for osteosarcopenic obesity with or without type 2 diabetes. Many also stress or focus on both the negative outcomes of this linkage, and uniformly provide a strong call for solutions to minimize falls risk, as well as osteosarcopenic obesity among the elderly [17-19]. Several continue to provide both innovative and feasible potentially impactful insights into the link between falls and associated bone and muscle deficits and a need for customized physical activity and behavioral based interventions [10]. Others focus on identifying risk factors for falls among the older adult population, which turn out to be numerous, but largely and essentially modifiable or preventable. In this respect, whereas obesity, characterized by excessive fat accumulation, has been traditionally associated with the induction of a higher bone mineral density than not, recent data suggest a favorable bone microarchitecture profile in these patients does not confer adequate fracture prevention in all cases, and the risk of fractures in an older adult with high muscle, bone, and regional fat deposits may vary depending on the skeletal site impacted [16].

Adding to the burden of poor bone health and high risk for falling and fracturing a bone in aging overweight adults is the presence of a possible ensuing or underlying type 2 diabetes health profile that may foster weight gain as well as bone attrition and possibly other

ensuing comorbid health conditions such as osteoarthritis plus secondary bone and muscle structural deficits, fat deposition and inflammation, plus progressive fragility, despite the availability of advanced pharmacologic weight reducing approaches. Moreover, the pervasive false belief that obesity has little impact on fostering fractures and negative bone attrition states may lead to irreversible functional deficits [33-38].

8. Additional Findings

Crivelli et al. note that when viewed as a whole, it seems fair to conclude both visceral and subcutaneous fat may be detrimental to bone health in pre- and postmenopausal women, as well as men and in both cases severe obesity may increase the risk for incurring a fall and subsequent fracture as well as poor healing trajectories thereafter, even in young adults [39]. Moreover, in view of what has been observed relative to the fat muscle ratio variable in elderly persons arm and trunk muscles, the belief that obesity confers protection against bone fractures must be challenged especially if other conditions affecting people with obesity, such as type 2 diabetes that can foster osteosarcopenia- a debilitating condition characterized by concurrent bone loss and muscle wasting, prevails [10,40].

Obesity is also associated with a possible vitamin D deficiency, as well as impaired muscle function, and sarcopenic phenotypes, and possibly thereby with a further fracture risk and damage to both the bone itself and/or the surrounding soft tissue and its structures [41,42]. Indeed, contrary to expectations, individuals diagnosed as being both obese and having a type 2 diabetes do appear to have a substantive risk of sustaining impaired bone quality alterations and a possible elevated risk of fragility fractures, despite their higher and/or unchanged bone mineral density and often even in the face of efforts to alter bone cell metabolism [22,44]. In addition, although appearing site-specific and reducing the risk for fractures in some locations, but not others, this degree of bone protection may depend on the degree to which body weight/body mass index is a risk factor for falling in the elderly especially those with excess abdominal fat sites and a heightened higher sway area and sway range, plus a lower complexity of anterior-posterior center of pressure responses when walking that may impact dynamic balance adversely as well as muscle strength, and lower limb or gait patterns, especially in those with generalized pain, neuropathy and painful foot ulcers in those with type 2 diabetes [5,7,45,50-53].

In this regard, Gkastaris et al. conclude the interaction between obesity and bone metabolism even though complex and not fully understood to date has enormous neuromechanical implications for increasing fracture risk [54]. These include bone marrow and muscle fat increases, muscle strength declines, bone metabolism, bone vascular and energy associated mechanisms among others [55]. Also damaging may be obesity correlates linked to multiple chronic inflammatory and oxidative stress influences, as well as possible impaired glucose control pathways, and over time, altered bone metabolism and marrow adiposity, plus dizziness, neurosensory and muscle power declines that can collectively impact balance control and induce an unwanted progressive state

of bone fragility, gait abnormalities, as well as increased obesity and falls risk [5,7,43,48,53,55-57]. As well, the allied influence on bone of continuous over nutrition, poor nutrition, possible fears of falling, diabetic sensorimotor problems, and a resultant state of limited mobility or biomechanical abnormalities may well interact to engender a perpetual web of negative associations and excess debility including blood pressure disturbances, painful neuropathy, skeletal muscle atrophy and dysfunction and pervasive cognitive manifestations that can ensue in late life to a debilitating although possibly preventable [43,52,53,59].

Indeed, several researchers show or predict that specific emergency department and service personnel actions may be essential to help offset secondary falls and fractures in aged obese fallers, including-

- Salient screening protocols
- Assessments
- Structured action plans
- Staff education [58].

The original qualitative investigation by Goldberg et al. that addresses this topic further stresses an important contribution can be made here in determining the optimal post-acute fall prevention intervention strategy that can avert future injuries and fractures. due to a possible incremental age-related redistribution of fat and its infiltration into bone and muscle [59]. Moreover, untreated osteoporosis as experienced by the elderly that increases the risk of sarcopenia, and fractures, may create a vicious cycle of progressive disability and pro-inflammatory health responses that can impair both bone and muscle structures if not duly addressed [17].

9. Other Clinically Oriented Insights

Among those multidimensional falls risk factors as observed in various obese sufferers that might be attended in emergency settings are: a) The use of multiple medications, including diabetic drugs, b) Excess muscle weakness, and c) A possible vitamin D deficit.

Others include the presence of a record of various motor and/or sensory neuropathies, subnormal blood glucose levels, poor balance, and impairments in mobility, or excess anxiety. As well, neuromuscular control deficits, high rates of body and foot pain that are consistently implicated in sarcopenic obesity and indirectly in inducing falls fears and depression should be noted [5,7,20].

Additional factors often cited to heighten falls risk in this regard that may be reduced if thoughtfully treated in a timely manner are a role for:

1. Impaired sleep cycles [43].
2. Medication overuse/misuse/underuse.
3. Lack of awareness of obesity/diabetes falls/falls injury linkages.
4. Poor appreciation of the role of nutrient/micronutrient intake.
5. Loss of muscle mass, possible muscle myopathy, sensory decrements.
6. Mild cognitive motor impairments and reduced cognitive

functioning [36,43].

7. Poorer than anticipated walking performance/endurance.
8. Role of knowledge, attitudes and perceptions related to falls prevention [35].

In particular, the possible presence of age associated sarcopenia, as this effects muscle mass adversely, as well as muscle force capacity, along with possible muscle afferent conductivity, and walking speed may have the additional effect of disturbing as well as delaying inherent protective motor functions that heighten the risk of incurring an injurious fall if overlooked. In this regard, older adult obese type 2 diabetes cases with sub optimally efficient ankle muscle coordination when trying to balance, and those with diabetic foot ulcers or deformities, muscle spindle afferent alterations, poor vision, and peripheral neuropathy who are likely to walk more slowly and with uncertainty need to be carefully monitored as well [60,61]. Also indicated are efforts towards promoting weight reduction and fostering optimal strength and postural control [57,69]. Madigan et al. suggest an expanded role here for task-specific training to improve compensatory stepping responses that may reduce falls in the obese and that should be encouraged given the individual-specific anthropometric and functional consequences of obesity, such as reaction time and muscle strength deficits [62,69].

As well, careful cognitive assessments including the client's self perceived falls risk is likely to prove beneficial in allaying the possible adverse impact of failing to apprehend any 'danger' when walking especially when coupled with a presence of possible subnormal timed and well modulated neuromotor processing responses [30,44,63]. Added to this may be harmful eating practices such as a diet high in sugary contents and low on micronutrients that can impact cognitions and cognitive declines, muscle fat mass encroachment, poor muscle based postural control mechanisms plus incautious movement behaviors and others [23,65,66]. At the same time very carefully devised medication regimens plus regular medication reviews appear imperative, alongside regular balance, gait and muscle strength analyses as indicated. Others encourage the inclusion of vitamin D serum assays, glucose monitoring as indicated, specific efforts towards minimizing pain and distress, as well as safely raising aerobic capacity, muscle strength, reaction time, and poor dynamic balance [21,41,67-72,77].

To this end, Whelen and colleagues propose the use of wearable digital health technologies designed to provide vital personalized real time behavioral and physiological reports [73]. This approach can help provide possible feedback messages and directives for change so as to enable the development of tailored client specific and time based modifiable intervention plans to help avert the excess use of impairing medications and their falls linkages [35, 74], especially in cases with signs of neuropathy [46]. Biomechanically oriented therapies to improve gait appear as important or even more important than medications or nutrition oriented approaches alone and where relevant a supplementary focus on cognitive training, vitamin D optimization efforts, and a comprehensive frailty informed assessment protocol may prove

valuable [46,75,76]. Recognition of the above and that the presence of excess body fat has profound muscle located implications as well as long term health implications also implies a concerted need for regular follow up assessments of the client, as well as possible intensive muscle building and lifestyle interventions [17,78]. Indeed, it appears that in all cases those older at risk adults who are diagnosed promptly and followed up accordingly will likely be more successful in accomplishing their life's goals than those who are not.

10. Discussion

This current overview tends to affirm falls among the elderly have been and clearly remain a leading cause of the persistent high demand for prompt preventive and intervention emergency department services, and others, in efforts to avert further falls, and weight gain especially in the face of evident, type 2 diabetes, osteoporosis, osteosarcopenia, plus gait disturbances, sleep problems, high waist to hip measures and central adiposity [22,43]. Little evidence exists however, to guide secondary prevention in this population with any degree of certitude [79]. Rather, the need here may well be overlooked by a consistent failure to follow up obese fallers who report 'no falls injury' [21]. The methods of acquiring data as well as subjects in reported studies, data sets that rely on interpretation or memory, and reliance on the body mass index and grip strength to define obesity and osteosarcopenia presence alone may account for the varied conclusions that have been reported as well as the documented persistence of a failure to prevent late life fractures in general among overweight older adults with or without type 2 diabetes. Moreover, the specific determinants of future falls and fractures are often not studied to any concerted degree, nor discussed. There are also many misconceptions in this regard and a belief in current pharmacologic interventions to minimize weight in isolation and thereby restore health, or the view obesity has no clinically significant bearing on fracture risk or that obesity heightens falls risk but not injury extent [10,19,52].

Thus despite many years of study, falls among the older obese adult with or without type 2 diabetes who may represent up to a third of older adult populations in the West as well as increasingly in former less well developed nations remains a major public health concern among all aging populations especially in the face of concurrent rises in osteosarcopenia, a prevalent health state in later life for many [29]. Particularly noticeable in this regard is the failure of pharmacologic methods of obesity and/or diabetes and sarcopenia management to address many of the key determinants of falls in this population, such as a possible diminished proprioception sense, declining muscle activation mechanisms, poor walking balance, and movement accuracy [14,80]. Bone protective medications may also be offered or advocated less often than not to the obese adult [2].

Indeed, whereas falls and their potentially disabling consequences in older populations have been discussed for many many years, the reasons for trying to do more to avert falls and their consequences in this population is that its associated has far reaching costly public health and personally linked impacts including multiple falls, falls

injuries and fractures, especially secondary fragility fractures that remain strongly associated with obesity as defined by the body mass index $> 30 \text{ kg/m}^2$, a common numerical measure and very widely employed [14,22]. Although it appears that a possible chronic pro-inflammatory state, and secondary complications, coupled with various forms of pharmacotherapy can contribute to the elevated risk of fragility fractures seen in older individuals with obesity and Type 2 diabetes, the lack of consensus here surely drives the inadequacy of sound preventive practices as well as beliefs [22]. As in other realms of chronic health research shortcomings this above state may be due to the lack of any well articulated and designed research efforts in this realm and indefinite diversely measured obesity estimates, for example measures of body fatness versus body mass indices that do not concur [8,52,70], false beliefs that if present, an obesity state protects bones from fracturing, plus reliance on self-reported falls events in cross-sectional or aggregate studies of women not men or men and not women [10,52] and that cannot establish causation or a role for reverse causation or actual outcomes [8,14]. Alternately, erroneous beliefs that nothing needs to be done, or the notion that nothing can be done even of the face in remediable falls mediators such as walking balance, walking difficulty, possible deficits in joint kinesthesia, plus emergent states of kinesiophobia, neuropathy, dizziness, hyperglycemia or hypoglycemia and poor overall health that may play a role [69,81].

Recently too, it is shown that obese type 2 diabetes cases who lose weight via pharmacologic interventions may also lose muscle mass, and thus a strong likelihood remains for them of being at risk for recurrent falls and possible heightened bone damage on any unexpected bone impact. Indeed, a lack of attention in this regard, and especially in light of the emergence of a possible drug induced frail type of obesity they may predictably remain at risk for a major fall and/or multiple fractures [23]. Deficient knowledge as to why this sub group may tend to fall backwards and sideways, unlike healthy weight elders, may also jeopardize preventive efforts from attaining optimal results [22].

At the same time, despite a lack of universal consensus, it is challenging to dispute a need here for more targeted immediate measures as well as ongoing strategies to foster environmental safety, access to care and if needed to nutritional sources, stress control and exercise options, cognitive and emotional wellbeing plus the importance of accessible tangible and empathetic forms of support as indicated [29]. Strongly indicated here is a comprehensive tailored approach to treating the obese older adult with osteoporosis and type 2 diabetes risk more proactively, including helping them make investments in lifestyle modifications, weight management challenges, as well as fall prevention strategies, and if indicated pharmacological intervention safety [15,17,35]. A sound clinical role for considering a) cognitions and health behaviors, b) food insecurity, c) medication monitoring, d) lifestyle modifications, e) educational factors, and f) gait training perspectives among the overweight older adult falls risk population is especially advocated [26].

In the interim, osteosarcopenic obesity – a syndrome recently

identified as a condition encompassing osteopenia/osteoporosis, sarcopenia and obesity should perhaps be assumed to be present if not a leading future falls risk factor helping to advance the risk of fragility fractures in those who are not treated optimally especially those with deficient balance [17,46] and type 2 diabetes [22]. Moreover, it can be assumed carrying excess body weight can indeed impact the mode of a fall, plus the onset of distal motor system muscle mass deficits, poor exercise tolerance, and associated bone mass structural problems, and with enormous cascading interactive adverse ramifications, especially in the morbidly obese [22]. In essence, research strongly suggests that sarcopenic obesity and type 2 diabetes not only increases the risk of falls in later life, but possible one or more potentially devastating fractures [24]. Moreover, even though generally reversible, non tailored falls prevention approaches whether primary or secondary may prove ineffective, unsafe, or undesirable [eg., if delivered remotely instead of face to face to an older adult] and poorly aligned with the clients' personally desired life goals, falls self-efficacy status, outcome expectation beliefs, and degree of multimorbidity.

Those who may benefit from intervention most may be those at highest risk, and include females older than 75 years of age, those with neuropathy and/or retinopathy, dizziness or subnormal vestibular motion perception manifestations, proprioception deficits, muscle strength losses, high body mass indices, low falls prevention efficacy and poor stability, plus possible bone losses in the face of excess weight losses [33,37,38,52]. In addition, those employing psychotropic drugs and diabetes medications that induce hypoglycemia, especially those categorized as having a polypharmacologic history, neuropathy, and deficient reaction time appear to be at high risk for single falls as well as recurrent injurious future falls [9,69]. In particular, those with longstanding type 2 diabetes, obesity features, as well as osteoporosis, and frailty or falls histories who may incur fractures quite readily, should be sought out and duly targeted as a precautionary measure [2,9]. Conversely, those less likely to fall and sustain a fracture are those with a higher appreciation of their falls risk, higher degrees of glucose and balance control, gait scores, more optimal body weights, and leg muscle strength. In addition, those who are active, and who receive and carry out relevant instructions including those that address muscle attributes and sarcopenia presence or extent followed by personalized prophylactic treatments, such as well designed targeted food based muscle and bone building diets need to be especially mindful when walking or weight bearing [69].

In this regard, while not readily enacted, it appears more intense and visible continuous community wide efforts towards preventing the well described costly obesity and type 2 diabetes epidemics alongside osteoporosis prevention, as well as targeting high weight older adult falls fracture survivors, may have a fairly resounding impact on the extent of related acute and future falls plus fracture incidents than not, and is strongly advised. Hospital policies and resources to address these overlapping issues as well as their mitigation may also prove helpful, for example advocating removing sugary drinks and processed fat laden food products from hospital vending machines and replacing them with healthy

products.

Additionally, clinicians can help by stressing the importance of weight issues in the context of falls prevention and not neglecting to consider the related specific import of:

- i. Periodic falls risk assessments/referrals to experts as indicated.
- ii. Home based falls prevention interventions.
- iii. Multidimensional/sensory integrated exercise programs [7].
- iv. Nutritional oriented education and resource support.
- v. Conducting periodic medication reviews [59].
- vi. Efforts to reduce distress, falls fears, anxiety and depression [12].

Physical therapies known to improve proprioception, muscle strength, balance, bone health, and walking ability, as well as pain appear especially warranted and are among the most promising for averting obesity linked type 2 diabetes falls risk, alongside balance control. Physical therapy health providers are also well positioned to organize any needed parallel cognitive therapies that focus on moderating or eliminating mindless harmful repetitive behaviors and beliefs, and immobilizing fears of falling, often not associated with obesity, while tackling safety, possible poorly healing foot ulcers, gait deficits, and non adherence issues. They can help encourage their client's ability to self-monitor and mediate their glucose and physical activity levels, and may thus be instrumental in efforts to heighten the impact of having strong muscles not only on falls prevention, but on reducing abdominal/subcutaneous and bone adiposity, and thereby on fostering more optimal muscle power, energy and physical function states of being [7,73]. As opposed to remotely delivered generic messages, they and other service providers can work together to formulate an actionable therapeutic program that is mindful of the possible anthropometric and functional consequences of diabetic associated obesity impacts that may impose limitations on the ability of the obese older adult to perform compensatory stepping responses following large postural disturbances readily and others and being fearful of falls may not want to engage in weightbearing activities [7,9]. Additionally, they can identify and address those aspects of nutritional health deemed crucial for preventing obesity as well as muscle atrophy in this group and their individual and collective personal, communal, national and global multiple negative projected impacts [6,7,12, 62].

However, although it can be argued adherence to any of the above recommendations will be beneficial, the adoption of a concerted holistic multidimensional approach delivered by an empathic set of providers may likely prove more instrumental in this regard than not. As well, an approach that addresses both excess general as well as abdominal fat deposits as potentially harmful to bone may foster a reduced falls and bone fragility proclivity, alongside excess hospital usage, and overall functional health declines to a substantive degree [85].

In this regard, research does show older obese fallers and their caregivers do welcome advice from physical therapists and others on how to improve their safety and overcome fears of mobility and

repeat falls, especially those due to muscle strength and endurance declines. In addition, aside from the necessary injury assessment, the provider can make further impacts here by undertaking efforts towards identifying and removing reasons for the fall as far as possible, including the provision of fall prevention education and resources. Currently, however, many fall risk assessments and falls prevention intervention strategies are largely multimodal, and formulaic and do not embrace any specific role for countering obesity without anti-obesity medical interventions or diet based approaches that foster excess weight reduction. The role of weight loss in fostering bone attrition and frailty fracture risk is also rarely discussed [33]. Therefore, the results of most stand alone studies are difficult to apply to all falls incident cases, and rarely identify the possible impacts of other individual obesity as well as falls risk factors, such as poor sleep health. Applications are also potentially limited in the face of a widespread failure to conduct any follow ups to examine long term falls outcomes whether injurious or not. The population of older adults who have fallen is also less likely to be studied if they are excluded from a study for various health reasons, thus directives applied on the basis of cumulative knowledge may fail, especially in the face of obesity or diabetes associated cognitive motor impairments, or the inability to carry out all aspects of intervention delivery as well as safety recommendations.

Barker et al. however suggest providing a telephone-based, patient-centered falls prevention program may reduce falls even if not deemed injurious in older people with obesity profiles [79]. In this regard, Cho et al. suggest that central obesity be measured when assessing older adults' fall risk and addressed accordingly to prevent recurrent falls as well as fall-related injuries [21]. In the interim, it is agreed, obesity is strongly associated with multiple modifiable risk factors for falls including moderate or severe pain, the negative effects of stressful exercise, and discomfort, and poor glycemic control that should be addressed mindfully, as indicated [67].

11. Conclusions

On the basis of the literature presently explored we confidently conclude:

- Older obese adults with type 2 diabetes will continue to fall at high rates if no major advancements or robust translatable conclusions about their many modifiable antecedents can be reached in a timely manner.
- Early well conceived screenings and ongoing monitoring of falls risks, followed by patient specific preventive strategies and action plans that aim at enhancing physical activity and weight bearing are likely to reduce much harm and undue older adulthood distress, and overall suffering costs [67].
- Those obese cases in the higher age ranges who are frail, have multiple health distress provoking challenges, and exhibit mobility limitations as well as central obesity, pain, and low vitamin D levels should be specifically targeted to avert the sizeable risk of one or more falls and possible bone fractures in the future, plus the onset or exacerbation of co-morbidities including obesity, and the use of multiple medications

[33,67,78].

- By helping to bridge the gap between lifestyle medicine and fall prevention offerings and conducting salient physical assessments and follow ups, comprehensive medication therapy management [59], and multi factorial collaborative holistically oriented interventions, emergency services personnel are well placed to be key players in arresting this abovementioned cycle of functional declines and possible premature death [79,85,86].

To optimize much needed clinical preventive efforts, research samples studied should aim to include high age adults and account

for survival biases as this may impact the obese population of elders more severely than healthy aging adults. Both men and women, and their ‘actual’ voices, rather than data extracted from population based surveys assessing subjective response attributes based on memory and applied in regression analyses. As well, in addition to universally agreed upon validated data collection procedures, plus clearly defined inclusion and exclusion criteria of representative samples, well tested agreed upon obesity assessments and definitions, plus physiological measures as well as mobility indicators will be especially advantageous in all likelihood [52,67,81].

TAKE HOME MESSAGE

Obesity as well as osteosarcopenia and type 2 diabetes may be magnified in the community dwelling older adult population especially in the face of any heightened injurious falls propensity and a failure to address this possibility insightfully and immediately, and thereby ensuring falls will remain the leading cause of unintentional injuries across all age groups and that prompt many emergency room visits among older overweight adults [82].

To help prevent falls and secondary fractures in older people [even if disputed as salient by some], factors such as dynapenic abdominal obesity should be taken seriously in our view, and corresponding intervention measures should be implemented accordingly [10,12,25,44].

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