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Short Communication

Trilogy of Covid-19 pandemic inactivity, Vitamin D deficiency and Genu Valgus knee deformation: Indolent manifestation of concern in preadolescents

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ABSTRACT

The Covid-19 pandemic has affected the health in myriad ways. The direct affection may lead to respiratory infection. An indirect effect of Covid-19 has manifestations on the physical, mental and behavioural attributes in majority of the age groups. The forced restrictions, limited activities, and changed lifestyle have aggravated the deleterious effects of the sedentary lifestyles.

The management of the physical activity for all age groups especially pre-adolescents took a relative back-seat during the Covid-19 restrictions with no immediate suggestions for an active treatment protocol strategy. The clinicians in general, emphasised on the conservative measures to manage the increased incidence of vitamin deficiency and osteopenia majorly with consultations based on telecommunication without clinical evaluation. The subsequent delayed assessment showed a profound negative impact amongst the pre-adolescents with significant progression of knee deformation and increased outpatient clinic presentation of genu valgus for management in later phase of pandemic. This has posed a unique Covid-19 post-pandemic manifestation of concern.

The trilogy of Covid-19 restrictions induced poor physical activity, vitamin-D deficiency, and deformation of knees to valgus angulation have crippling effect in the pre-adolescent age-group. The delay in timely identification and medical management for the pre-adolescents has aggravated the joint deformation compromising the functional outcomes. The orthopaedic surgeons are now challenged and burdened to manage pre-adolescents knee deformity for corrective medical and surgical measures. On literature review, the guidelines are sparse for the paediatric orthopaedic management. The silent worsening with increased morbidity presents a matter of substantial concerns.

An individualized management strategy for pre-adolescents is strongly recommended to manage this "silent" morbidity.

1. Introduction

The Corona virus (Covid-19) pandemic presented with abrupt and unprecedented challenges for the humans. The pandemic has had effects on the physical and mental activity for all age groups.[1] The pre-adolescents were affected less during the earlier phase of pandemic. There were more affections in the elderly, adult age, and adolescent age groups with varied intensity and presentation than in the younger generation.

The preadolescents had been at a decreased vulnerability for Covid-19 affection with majority affected by mild symptoms.[2] However, the confinement of preadolescents to home with reduced or limited physical activity caused significant vitamin deficiencies. The resultant being an increased knee deformation and clinical manifestation of genu valgus in the ensuing two years of pandemic affection.

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The closure of schools, sedentary lifestyle, poor level of outdoor activities, and lack of physical exercise have caused an increased risk for likely deterioration in the growth pattern of pre-adolescents.[2] The reluctance for consultation due to lockdown restrictions, parental pressures to keep children home-bound to avoid Covid-19 exposure, and inadequate treatment of vitamin deficiency have all contributed immensely to an increased inactivity with likelihood of angular knee deformation. The multiple compounding factors have caused a manifestation of concern for medical and surgical measures to improve the functional outcomes.

Even after two and a half years of pandemic, to the best of our knowledge, no precise data exists to illustrate the correlation of vitamin-D deficiency (VDD), Covid-19 and Genu valgus. The trilogy needs to be identified and presented for researchers to base their future studies with focus on improving the management of knee deformity in the pre-adolescents.

2. Covid-19 Pandemic and VDD

The Covid-19 pandemic hastily applied significant physical restrictions and limited the outdoor activities for an extended period of few months in most of the countries.[1] The ensuing isolation resulted in decreased exposure to sunlight with subsequent increased VDD.[3] It resulted in multiple poor effects in the healthy population in general.[1] The systematic reviews present conflicting statements regarding their direct association.[4–6] The systematic review had identified that the VDD was present in most of the individuals affected by Covid-19.[4,7] The review further highlighted that a VDD population had three times more chances of Covid-19 affection and five times more prone for a severe infection.[4]

The beneficial effect of Vitamin-D in decreasing the Covid-19 severity has been related to its role in immune system functioning for both innate and adaptive immunity.[8,9] The induction of sufficient cellular responses to reduce the levels of the inflammatory markers especially C-reactive proteins has been observed.[5,7] The Vitamin-D may also benefit by preventing cytokine storm which was the main cause for high mortality in Covid-19.[7] However, the reviews have presented a heterogeneity on the meta-analysis with inadequate conclusions based on subgroup analysis due to compounding variables for age, sex, and presence of comorbidities.[5–7,10] The risk of bias in the reviews presented has been rated as high.[6,10] The reviews identify the elderly to have more susceptibility to Covid-19 infection in VDD state and the elderly to have occurrence of more severe infections.[5,10] In our observation, the available systematic reviews on VDD and Covid-19 correlation, lacks any specific observations for the pre-adolescent age group.

3. Covid-19 Pandemic and Orthopaedic Manifestations

The orthopaedic surgeons have been challenged with bone and joint related manifestations in the Covid-19 pandemic. The incidence of spontaneous osteonecrosis, avascular necrosis of femoral heads, VDD, myositis, arthralgia, myalgia, immune complex related disorders, and flare ups of joint arthritis and osteoporosis have increased.[11–13] The incidence of septic infection, post-operative affections and soft tissue abscess have manifested as concerns in Covid-19 affected individuals.[13]

The study on Covid-19 patients with musculoskeletal manifestations suggest more musculoskeletal concerns in obese and diabetic patients.[12] No direct linkage has been established with presence of Covid-19 in musculoskeletal system such as synovium, muscles or bone.[14] The indirect effects have presented more commonly as fatigue, myalgia and arthralgia.

In our observation, no study links the paediatric manifestations of angular knee deformity of genu valgus to Covid-19 related VDD as a manifestation.

4. Covid-19 Pandemic and Implications for Paediatric Orthopaedics

The paediatric group has been affected during Covid-19 with mostly mild affections.[1,2,9] Though, severe multisystem involvement with autoimmune disorders have presented too but in isolation.[2,9] Paediatric orthopaedics was affected by the Covid-19 pandemic. There was a substantial decrease in the number of sports related paediatric trauma cases.[15] The elective surgical procedures were withheld in early phase of the pandemic with resultant backlog of cases.[16] The prevalence and management of the lower limb trauma during Covid-19 pandemic was different to usual protocols advocated earlier. The emphasis being on the conservative measures as much as possible.[15]

The closure of schools and academic institutions during the Covid-19 heightened the inactivity amongst the pre-adolescents. The online programmes were initiated for preadolescents with aim of restoring the academic activities however, it compromised the outdoor physical activities. The culture of social interaction had a massive shift from physical to online communications through electronic devices.[2] This was overall encouraged by the community to lessen and reduce the possible exposure and further chance of contacting the Covid-19 infection.

In our personal observation, we strongly suspect a significant impact of inactivity in the preadolescents with an increased clinical presentation of the angular knee deformity especially genu valgus in our outpatient clinics. In our outpatient clinic, in the pre-pandemic era we had 1-2 out of ten preadolescents with a valgus knee and in the post-pandemic era, we have every 2^{nd} or 3^{rd} preadolescent with

genu valgus. The magnitude of the indolent manifestation can only be gauged with our personal observation, where we observe an approximately five to six-fold increase in the clinical presentation.

The social isolation and reduced inactivity have heightened the VDD in preadolescents and manifested with genu valgus knee deformity. The VDD in probability aggravated the angular forces on the knees presumably with an increased sedentary lifestyle, confinement to abnormal sitting postures and stunted growth phase of the preadolescents during the pandemic. The hypothesis for the development of an angular valgus deformity in the preadolescents due to VDD induced by Covid-19 pandemic may need further validation with a randomised controlled trial.

5. VDD and Genu Valgus Knee Deformity

The normal preadolescent has a valgus knee angle of 7-8 degrees. The physiological genu valgus develops from newborn tibiofemoral angle of 10-15 degrees of genu varum to straighten and lead to 10-15 degrees of genu valgus till three years of age.[17] The physiological deformities are normally observed till five years of age and thereafter they normally resolve spontaneously attaining corrections.[17,18] Any persistence of deformity in pre-adolescents age group beyond 8 years require evaluation to ascertain the aetiology.[19]

The aetiological causes for genu valgus may include idiopathic, congenital, traumatic, metabolic, neuromuscular, infections and generalized disorder affections.[17,19] The metabolic causes include rickets and renal osteodystrophy. A severe VDD results in osteomalacia in adults and rickets in children.[6] The VDD or vitamin-D resistant rickets presents typically with genu varum and renal osteodystrophy presents with genu valgus deformity commonly.[17] The vitamin D supplementation of 600 UI/day beyond 12 months of age in paediatric population has been usually recommended to prevent rickets and osteomalacia.[9] The effect of vitamin-D supplementation to prevent Covid-19 in the paediatric subgroup lacks any confirmatory study.[9]

6. Discussion

The Covid-19 pandemic kept the pre-adolescents confined to homes for almost two years. The physical activity was generally limited to occasional outdoor activity with poor and deficient exposure to sunlight.[3] The pre-adolescents were commonly instructed to pursue the schooling activities online confining them indoors. The sporting activities were curtailed with the fear to avoid exposures to Covid-19 infection.[16]

VDD has been underestimated in the preadolescent age group.[20] Studies on the healthy school children of the preadolescent age group from northern India evaluated for VDD found to have clinical and biochemical evidence for a high prevalence of deficiency.[21] The VDD was compounded by poor nutrition resulting in poor scores in the lower socioeconomic status group as compared with upper socioeconomic group. The growing skeletons in the preadolescents will have higher mineral demands and VDD presumably compounds to cause greater joint deformation forces on loading of the knee joint.[21]

In our country, now almost after two years of Covid-19 restrictions, the preadolescents have been encouraged to resume their school and outdoor activities. The parental concerns have increased in the post Covid-19 restrictions on the resumption of activities for the pre-adolescents.[1,3] The review studies on effect of social isolation during pandemics on preadolescents have focussed more on the negative impact on mental illness including stress and anxiety disorders due to the limited socializing and less on the physical illnesses.[3] The literature has no reports on preadolescents affected by angular knee deformity in Covid-19 pandemic. Though, a case report of VDD induced rickets in an 18-month old child highlights the ill-effects of Covid-19 pandemic induced social isolation.[22]

In our observation, the parents have now reported in outpatient clinics with increased concerns. In the past two years of Covid-19 pandemic, now we observe an increased concerns of child clumsiness, realization of cosmetic knee deformity and apprehension of functional dysfunctions amongst pre-adolescents during running or playing activities on the resumption of outdoor activities.

The obesity has been commonly and closely associated with knee deformation.[9] A relatively increased calorie intake with the decreased physical calorie consumption leads to a high body mass index.[23] Obesity and its causal relationship to genu valgus have been recognised to have a strong and significant influence.[20,23,24]

The manifestation of concern remains ill-understood with no direct linkage possible. However, the outpatient clinics present with increasing incidence for a progressive angular knee deformity requiring close observation and assess the need for surgical corrections. The knee deformity are unlikely to resolve though the decision to offer surgery should depend on the age of presentation, progression of the valgus deformity, functional impairment, and failure to arrest the deformity by conservative measures.[17] The options for surgery include partial epiphysiodesis, hemi-epiphyseal stapling, and corrective osteotomy.[17,19]

7. Recommendations

We recommend for:

1. Systematic review or Randomised controlled trials to assess the correlation effect of VDD, Covid-19 and knee deformation to further quantify and gauge the severity and extent of such affection in the pre-

adolescents.

2. Interventional studies to judge and define any positive effect of the Vitamin-D intake in a Covid-19 infected person. The present available reviews have not shown any clear clinical benefit of Vitamin-D supplementation in reducing the Covid-19 related illness.[10]
3. Initiation of measures to correct the modifiable risk factors. A balanced diet to provide for adequate nutrition, reduction of weight to off load the knee joints, proper adequate exposure to sunlight for Vitamin-D, and therapeutic supplementation in proper desired dosages should be undertaken.
4. The surgical correction of any deformity of 15 degrees or more in a preadolescent of age more than 10.
5. Educate the population especially the preadolescents on the importance of VDD and its deleterious effects.[25] The emphasis being based on old proverbial saying "Prevention is better than Cure".

8. Conclusion

The pre-adolescents need a prioritised screening and management of VDD to avoid the avalanche. There is an urgent need to identify the crippling trilogy of Covid-19 inactivity, VDD and angular knee deformation in an at-risk pre-adolescent to ensure timely management for an effective outcome.

9. Abbreviations

Covid-19: Corona virus, VDD: Vitamin D deficiency

10. Consent for Publication

The data presented has no disclosure to identify with any human involvement in the study.

11. Author's Contribution and Declaration

GG contributed to the study conception and design.

GG performed the literature search and prepared the original draft of the manuscript and reviewed the subsequent version with editing of the manuscript.

LT did review analysis.

Both the authors commented on the previous versions of manuscript.

All authors read and approved the final version of manuscript.

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13. Conflict of Interest

None.

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