Original Article

ECONOMIC EVALUATION OF VITAMIN A AND D DEFICIENCY IN PAKISTAN

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ABSTRACT:

Prevalence of vitamin A & D deficiency (VAD, VDD) is very high in Pakistan. About 43 percent of population is vitamin A deficient and sixty percent of population is vitamin D deficient. VAD causes vision problems and increases the infections by reducing the immunity in adults. Considerable children are becoming blind due to its deficiency every year. VDD reduces the weight of bone tissue and leads to fractures. Both are contributing to cognition loss in children that leads to reduction in school attendance. These deficiencies in adults cause loss of working hours and reduce the physical productivity. Moreover, medication also consumes considerable proportion of income of poor families. Current study attempts to monetize the economic losses of these deficiencies by estimating the value of cognition and physical loss among children and adults due to VAD & VDD. We designed a questionnaire and interviewed 90 doctors all over the Pakistan to estimate medication costs due to prevalence of vitamin A & D deficiency among adult males and children up to age 14. We also accessed the online sources as well. Our result reveals that due to VAD & VDD, value of annual cognition losses in children are $8 and $6.4 per child, respectively. Values of annual physical productivity loss in adults are $3 and $5.6 per person, respectively but the cost of medication is estimated to be $37 and $41 per person per annum, respectively. If we aggregate these costs at national level then it amounts to $8.8 billion per annum which is quite high and demands for an immediate attention. In order to control these deficiencies, an appropriate intervention like supplementation or food fortification is required.

KEY WORDS: Vitamin A, vitamin D, vitamin A & D deficiency, productivity loss, cognition loss

INTRODUCTION:

Pakistan constitutes only 11 percent of South Asian population but it is significantly contributing to morbidity and mortality rate of region. Pakistan stands at 2nd number in child (under five) mortality rate in the region[1]. Mainly this mortality rate is associated with under nutrition. Under nutrition refers to deficiencies of macro and micro nutrients that can be aggravated due to parasitic infections. Micronutrients deficiencies are prevalent in Pakistan and apart from the health costs in terms of disability and death; they cause huge economic costs in form of work loss as well. Their treatment cost also exerts an additional burden on people of low income class. Among all nutrients, vitamin A is an important nutrient for vision and in developing countries its deficiency leads to mortality of children under 5. Every year 0.2 -0.5 million children who are deficient of vitamin A become blind globally[2]. Vitamin A deficiency increases the risk of night blindness among pregnant women and it leads to maternal mortality. Its deficiency poses a risk of child survival as it can be a cause of life taking diarrhea and measles[3]. On an estimate in

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Pakistan 13 and 5.5 percent children under age five die due to incidence of diarrhea and measles respectively[4]. This all is due to the hugeprevalence of vitamin A deficiency in rural and urban areas of Pakistan. According to national nutrition survey of Pakistan (2011) 46 percent of pregnant women and 54 percent of children are vitamin A deficient.Mostly its deficiency prevails in those regions where economic conditions are poor and consumer diet is low in dairy products. Since in Pakistan sixty per cent women and children are exposed to food insecurity hence it is more likely that these people are undernourished in terms of vitamin A intake.

Distress of under nutrition does not end here, national disease burden due to children and elderly is increasing every year. Intake of energy rich and nutrient poor diet has increased the risk of under nutrition in all segments of population. For a growing child healthy growth of bones is necessary. Similarly an elderly person can lead a healthy life only, when his body supports his activities and his bone weight is satisfactory. But many studies and surveys indicates that incidence of bone fractures is huge in all cities of Pakistan[5, 6 & 7]. Reduction in bone weight increases the risk of fracture that is associated with vitamin D deficiency (VDD).Prevalence of VDD is reported up to seventy seven per cent in adults [8]. According to national nutrition survey (2011) prevalence of VDD is up to 66.8 percent among non-pregnant women and 68.9 % in pregnant females (Figure 1).
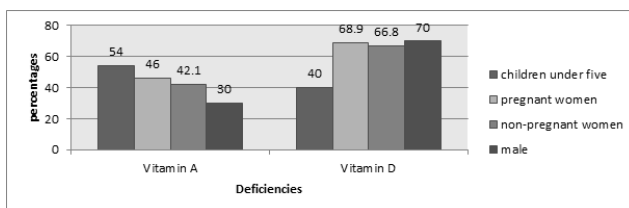
Figure 1. Prevalence of Vitamin A & D Deficiency in Pakistan *Source:*[6]

Vitamin D is produced by the skin and its production increases due to sunlight exposure. In elderly its production decreases and to maintain the recommended daily intake, supplementation is compulsory. In many countries its recommended dose is ensured by food based interventions at national level. Fortification of oil, sugar and flour is common intervention and it is highly recommended because these are staple foods. It can benefit both segments of population; one who are at risk of mortality and those who can be exposed to morbidity in future. However its supplementation can prevent the diseases due to deficiency but cannot cure them. As in osteomalacia; a condition associated with muscle weakness and bone pain, patient is at risk of developing osteoporosis as well. Osteoporosis is a fragile condition of bones and vitamin D supplementation can lower the risk of bone deformity and loss of bone tissue in women and elderly[9].

There are many solutions to defeat the deficiencies of vitamin A & D at national level like supplementation and food fortification. But in order to build a strong argument in favour of such programmes, it is necessary to estimate the economic losses of deficiencies. Hence present study is designed to investigate the economic burden of these deficiencies. Present paper estimates two types of cost associated with vitamin A and D deficiency; economic cost due to labour productivity loss and direct medication cost. Rest of paper summarizes the discussion as follows; section II describes the methodology, section III displays the results and section IV concludes the findings.

Methodology:

The value of annual labour productivity loss of unemployed and underemployed sick individuals because of vitamin A & D deficiency can be estimated by employing the equation;

$$VALPL = \sum_{i=1,2} (SD_i * WR * Pr_i (adult) * LFPR) \quad (1)$$

Where, VALPL is the value of annual productivity loss of individuals facing deficiency of i-th vitamin. SD_i is the average number of sick days per year due to *i-th* vitamin deficiency which are converted into year. WR is the annual minimum wage rate and Pr_i (adult) is the probability of adult being deficient of *i-th* vitamin. LFPR is the labor force participation rate. VALPLFE per child is estimated in terms of loss of future earnings due to fall in school attendance. Decline in school attendance affects the grades and cognition because school attendance has strong effect on cognition

development especially in lower income class[10]. High prevalence of micronutrient deficiencies in such income class seriously affects the future productivity considerably[11]. Cognition has direct relationship with future income because[12] conclude that one point increase in cognition increases the productivity by 2.5 percent. Hence, equation developed by[12] is used to calculate the loss of future earning per child per annum as;

Annual productivity loss/child = 0.025 * wage share * Per capita income * Pr (child) (2)

Value of annual medical expenditures loss (VAMEL) due to VA & VD deficiency can be estimated independently by using the equation;

VAMEL = $(CC_i + MC_i)(Pr_i (TP) *TP))$ (3) Where CC and MC stand for; average cost of consultancy and average cost of medication respectively. $Pr_i (TP)$ is the probability of total population being deficient of vitamin A & D. cost incurred due to inconvenience and travel is not incorporated as data is not available. Here study is assuming that every sufferer is taking the medication properly.

DATA COLLECTION:

In order to conduct the analysis by using the above methodology we used the both ways; secondary and primary, to acquire the data. Some of the estimates of prevalence and medication cost were not accessible from online sources so to include them; study formulated a questionnaire and made interviews with 30 doctors all over the Pakistan. Districts like Lahore, Faisalabad, Sadiqabad, Multan, Rahim yar Khan, Islamabad, Karachi, Hyderabad, Nawabshah, Bolan, Quetta and Peshawar were brought under investigation. Study hesitated to inquire about the prevalence of micronutrient deficiencies directly from the household as knowledge about micronutrient deficiencies is quite limited among households. Only 24 percent household has knowledge of vitamin A deficiency[13]. Thirty doctors in hospitals and clinics were surveyed and average of their response was taken in the analysis. To take the complete picture of vitamin A prevalence in Pakistan, study incorporated all age groups and took the average of them. Mainly women and

child under age five are reported by online sources and data on adult males and children from 5-14 is not available. Study also considers this segment of population. Table 1 summarizes the estimates required to conduct the analysis.

Table 1. Study estimates

Variable	Estimates		Source
	Vitamin A	**Vitamin D**	
Annual minimum wage	$1200		[13]
Per capita income	$1300		[13]
Wage share	44 %		Wage rate*labor force/GDP
Pr(child)	57.25%	45%	[13]
Pr (adult)	39.3%	68.5%	[13]
Sick days rate	1.3%		[13]
Population	179.2 million		[13]
LFPR	53%		[13]
Employed labor	47.3%		[6]
Consultancy cost/year	$8	$12	[13]
Medication cost/year	$23	$35	[13]

RESULTS:

We compute two types of cost associated with vitamin A & D deficiency;

- Cost due to loss of productivity
- Medication cost

Table 2 summarizes the results of equation 1, 2 and 3. It shows VALPL and loss per child due to VAD consumes 0.24 and 0.62 percent of GDP respectively. Losses due to vitamin D deficiency accounts 0.43 and 0.49 percent respectively. Here we are not taking the cost incurred due to measles and diarrhea to make the analysis simple. Medication of vitamin A & D deficiency is prolonged and their diagnoses are also expensive still our estimates are lower bound of medication cost because some time one disease diagnosis leads to another disease diagnosis and thus increase the medication cost. On an average 48 percent population is vitamin A & D

deficient. Total losses due to VA & DD are US$103.13 per capita. Keeping in mind the overall prevalence we can deduce the losses for all deficient population.

Total losses due to VA & DD = 179.2 million * 0.48 * 103.13 = $8.8 billion

This implies that it is consuming 3.8 percent of countries GDP. These are large amount of resources which can be preserved with appropriate intervention.

Table 2. Total loss incurred due to vitamin A & D deficiency

Economic cost	Annual estimates			Percentage of GDP/capital	
	Vitamin A $	Vitamin D $	Total $	Vitamin A	Vitamin D
VALPL per adult	3.24	5.66	8.9	0.24	0.43
VALPLFE-cognition loss	8.15	6.43	14.58	0.62	0.49
Medication cost/person	31	47	78	2.3	3.6
Total cost	43.31	59.82	103.13	3.3	4.5

CONCLUSION:

VA & DD is a serious threat to Pakistan health profile. Their deficiencies can affect the immune system and cognition in preschool children. In case of morbidity the school attendance of children and working days among adults will be compromised. Vitamin D deficiency leads to fracture of bones and its prevalence is quite high among Pakistan people. Such health outcome cause GDP losses and exert a disease burden over the economy of Pakistan. There is a need to intervene through proper measure in order to up lift the nutritional status of people. Here study has estimated the economic damages of VA & D deficiency up to US$103.3 per person per annum and nationally it amounts US$8.8 billion. VDD contributes more in work loss than VAD because its prevalence is high. In Pakistan nutritional status of people is poor and half of the population is not taking the

recommended daily intake (RDI) of various nutrients. The result of this hidden hunger is compromised health of children and adults. Pakistan child is stunted, wasted and dying due to micronutrient deficiencies. Similarly Pakistan adult is highly susceptible to infections and cannot exploit his potential to earn more. In this case food based intervention is need of hour. Pakistan government should start the supplementation of vitamins at national level or fortify a staple food with vitamin A & D. The cost saved due to vitamin intake will increase the real income of consumer as medication burden due to deficiency will be minimized. On the other side in case of improved productivity of individuals, the economic development of the country will also be the fruit of such intervention.

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Whoever wants to be a leader should educate him before educating others. Before preaching to others he should first practice himself. Whoever educates himself and improves his own morals is superior to the man who tries to teach and train others.

Hazrat Ali (Karmulha Wajhay)