# Asthma and L-Carnitine

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**"L-Carnitine Improves the Asthma Control in Children with Moderate Persistent Asthma"**
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*Kirk Hamilton:Can you please share with us your educational background and current position?*

Mohammed Al-Biltagi:
I am currently Associate Professor of Pediatrics, Pediatric Department, Faculty of Medicine, Tanta University, Egypt. I am a peer reviewer in many international scientific journals and Editor in the World Journal of Clinical Pediatrics.

*KH: What got you interested in studying the role of L-carnitine (LC) in asthma?*

MAB: LC corrects many metabolic and cardiovascular alterations. It was surprising to find that there were low blood levels in asthmatic children in one of our previous studies, so we wondered if their symptoms would improve if we supplied them with oral LC. Its effect in improving exercise tolerance stimulated us to study its effects on respiratory muscles and hence its effects on the bronchial wall, and subsequently its effects on childhood asthma.

*KH: What is the biochemistry of LC that might alter the pathophysiology of asthma?*

MAB: LC is a single amino acid that is considered to be non-essential because of the human body's ability to produce it on its own. LC is found in nearly all living cells which can be either provided by a biosynthetic pathway or by food. It plays a major role in lipid and energy metabolism and mitochondrial oxidation of long-chain fatty acids as it allows shuttling of long-chain fatty acids into the mitochondria where they are used to produce energy through its involvement in the peroxisomal oxidative metabolism in all cells. It also serves as a cofactor for various enzymatic reactions. It also works as an antioxidant and limits the deleterious effects of free radicals. It spares muscle glycogen, improves tolerance to physical activity, and reduces
muscle fatigue. It also decreases leukotriene synthesis through inhibition of lipoxygenase enzymes and hence decreases inflammation. At the same time, carnitine deficiency leads to toxic accumulation of long chain fatty acids in the cytoplasm and of acyl CoA in the mitochondria. The accumulated saturated and monounsaturated fats may have different effects on airway inflammation. So, LC supplementation improved oxygen saturation and decreased urine leukotriene E4 and inflammation in lung tissues.

*KH: Are children usually deficient in asthma? Were you looking for a deficiency to replace carnitine or were you using carnitine to have a drug-like effect?*
MAB: A lot of studies have shown deficiency of LC in asthmatic adults and children. Also our study proved that the free and total carnitine serum levels were significantly lower in children with moderate persistent asthma than in the control children. It is my opinion
the deficiency of LC is both a cause and a result of asthma. LC is an antioxidant which is used in asthma due to the increased oxidant stress in asthmatic children. Carnitine deficiency leads to toxic accumulation of long chain fatty acids in the cytoplasm and of acyl CoA in the mitochondria. The accumulated saturated and monounsaturated fats may have different
effects on airway inflammation. We used LC to replace the deficiency and also to get benefit from its antioxidant and anti-inflammatory effects. So it is used as a replacement therapy as well as its drug-like effects.

*KH: Where did you come up with a daily dose of 1050 mg per day of LC? How was it taken? With meals or away from meals? In a single dose or divided dose?*

MAB: The usual required dose for LC in most of carnitine related diseases is 50-100 mg/kg/day with a maximum daily dose of 2 gm/day. We used the dose of 1050 mg/day (3 capsules each of 350 mg; as it is the available form in our country). Most of the children's weights were between 20 and 25 kg, which made the dose valid for most of them. LC was given as a single daily dose of 3 capsules each morning 30 minutes before meals for 6 months. We gave it as a single dose to ensure compliance of the patients; however, there are some recommendations to give it in 3 divided doses. Optimal times to take LC include with breakfast, before a workout, after a workout and/or with an evening meal. Carnitine does not exert any stimulant effects, so it can be taken within three to five hours of bedtime without losing sleep.

*KH: Were blood levels of carnitine or other biochemical markers taken before, during or after the intervention? If so did they correlate with symptoms and supplementation with LC?*

MAB: At the beginning phase of this study, the total and free plasma carnitine levels were assessed in both the patient and control groups. One blood sample was collected from each of the control groups, and two samples were collected from the asthmatic children; the first sample was obtained during acute asthma exacerbations, and the second was obtained three weeks after the attack. We considered the mean of the 2 samples for analysis. We also collected another sample for total and free plasma carnitine levels from the patient group at the end of the study, after LC therapy. After supplementation with LC there were significant decreases in emergency department visits, total hospital admissions, and blood eosinophils (%) between children supplemented with LC compared to those asthmatic children with placebo or before supplementation. Also there were significant decreases in the serum IgE levels and improvement of pulmonary function tests and childhood asthma control tests became significant only after 6 months of starting the treatment. There was a significant positive correlation with total and free serum carnitine with the Childhood Asthma Control Test (C-ACT) and some pulmonary

function tests parameters (FEV1 (% of predicted)) before supplementation. However, there were no significant correlations between FEV1/FVC and the levels of total and free serum carnitine.

*KH: Can you tell us about your study and the basic results?*

MAB: Actually our objective was to investigate LC levels and the effect of its supplementation in children with moderate persistent asthma. The free and total serum carnitine levels were measured in 50 children having moderate persistent asthma and 50 healthy control children. The patient group was randomly divided into two subgroups. Subgroup A was supplemented with LC for 6 months while subgroup B was used as a placebo control. Both subgroups were assessed by pulmonary function tests (PFT) and childhood-asthma control tests (C-ACT) before and 6 months after carnitine supplementation. We found the total and free carnitine levels were significantly lower in the patient group than in control group. PFT and C-ACT showed significant improvements in asthmatic children supplemented with LC compared to those who were not supplemented.
From our study we concluded that the LC levels were initially lower in moderate, persistent asthmatic children as compared to healthy control children. Asthmatic children who received LC supplementation showed statistically significant improvement of C-ACT and PFT.

*KH: Were there any side effects with the LC therapy? How was the patient compliance?*

MAB: Yes there were some mild side effects like some gastrointestinal symptoms such as nausea, vomiting, and diarrhea; stuffy nose, hyperactivity and headache but none of these side effects resulted in children stopping their medication. There are other side effects not encountered in our study but recorded as side effects of LC therapy such as insomnia, agitation, palpitations, hypertension, skin rashes, fishy body odor and even seizures.

*KH: Who is a candidate for LC therapy? All asthma subjects? Only adults or children low in total and free carnitine?*

MAB: From our study all the asthmatic children can get benefit from LC therapy. However, we did not study children with normal total and free carnitine levels. Further studies are needed to confirm that. Of course adults or children with low total and free carnitine will get benefit from LC therapy and they are more likely to start LC therapy than children with normal levels. However, you should know that even with normal total and free carnitine levels, there still is a possibility of LC deficiency at the cellular level which cannot be ruled out by total and free carnitine.

*KH: Might this approach with LC be used for other respiratory conditions? (i.e. COPD, emphysema, etc.)*

MAB: There were a number of studies which showed a beneficial effect of LC in other respiratory conditions like neonatal respiratory distress syndrome; children with recurrent pulmonary infections; and

patients with chronic obstructive pulmonary disease (i.e. COPD, emphysema, etc.)

*KH: How can the public or health professionals use this information?*

MAB: Carnitine is very important in helping all cells in the body to work properly. Prior research has shown that LC (the form of carnitine used for supplementation) may improve lung function in people with various medical conditions. Few studies have looked at the role of LC in children with asthma. Genetic abnormalities, various medical conditions, and certain medications may lead to carnitine deficiency, according to the Office of Dietary Supplements. Whether lower blood levels of carnitine in children increase the severity of asthma, or whether asthma causes the lower levels of LC, or both, are still not known. If your child suffers from poorly controlled asthma, talk with a knowledgeable doctor about an integrative approach, and discuss potential options, including nutritional therapies to improve your child's symptoms and quality of life. Talk with a doctor to learn about the potential risks and benefits before giving your child supplements.

From our study we showed that:

1- Children with asthma had lower carnitine blood levels compared with healthy kids.
2- Children supplemented with LC had statistically significant improvements in lung function and symptoms after supplementation compared with before they were supplemented and compared with kids who took the placebo.
3- The supplemented group also had fewer emergency visits and hospital admissions, and a decrease in blood markers of inflammation (eosinophils, a main component of asthma), compared with kids who took the placebo.

*KH: Do you have any further comments on this very interesting subject?*

MAB: Still there is a need to study children with other degrees of asthma severity or other asthma subtypes or phenotypes. We still need to study the ideal dose and duration of LC therapy that ensures the maximum benefits from LC with the minimal side effects. We emphasize that LC therapy is only a supplemental add-on therapy. It does not replace other well known asthma medications like steroids or beta agonists.