



Role of Fluoride Compounds in Preventing Early Childhood Caries and Caries Progression in Children

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ABSTRACT

Caries is a contagious disease affecting most of the population from the first month of life. Almost half of the children under 6 years old are affected by caries and its consequences. The aim of the measures taken is to reduce its spread and level of its incidence in children, preventing health complications in the future. Limiting spreading of caries can decrease amount of invasive dental treatments and following complications. Reducing caries transmission and preventing its onset requires repetitive preventive methods that affect women from pregnancy, through infancy and childhood, and continue into adulthood due to its strong infectivity. This work aims to evaluate the effectiveness of fluoride-containing compounds from childhood onward, as well as comparing them to prevent and reduce the development of caries.

Key Words: Fluoride, fluoride varnish, ECC, Caries in children, Early childhood caries, Caries prevention, Caries transmission, Cariogenic factors, Cariogenic bacteria

INTRODUCTION

The WHO estimates the incidence of early childhood caries in children under 6 at 48%.¹ In the European Union, the average prevalence of dental caries in children under the age of 5 is at 37.2%. The highest prevalence of carry pertaining to the general population is in Poland (53,388 per 100,000). In children, it was most prevalent in boys - in this case Poland is in 2nd place after Lithuania (57.2%) and Latvia (57.8%).² Costly treatments, and the reduction of years in life in disability associated with premature teeth loss are the reason for the search for further solutions and the need to develop primary prevention especially in countries with a high prevalence of caries. Early childhood caries - hereafter referred to

as ECC - means that a child before the age of 71 months has at least 1 decayed tooth, a missing tooth as a consequence of caries, or a filled tooth.³ Risk factors for ECC include low socioeconomic status, existing caries, dental deposits, and increased *Streptococcus Mutans* populations in the mouth.⁴ This is a review paper to evaluate the effectiveness of fluoride compounds in the prevention and reduction of early childhood caries, and for the purpose of this paper, keywords were searched in the PubMed database such as: “fluoride”, “fluoride varnish”, “ECC”, “caries in children”, “early childhood caries”, “caries prevention”, “caries transmission”, “cariogenic factors”, “cariogenic bacteria”.

LITERATURE REVIEW

Author	Title	Conclusion
Harris R, Nicoll AD, Adair PM, Pine CM.	Risk factors for dental caries in young children: a systematic review of the literature.	The timing of infection of a child's mouth by cariogenic bacteria-especially <i>Streptococcus Mutans</i> - is an important determinant of caries risk in children.

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Manchanda S, Sardana D, Peng S, Lo ECM, Chandwani N, K Y Yiu C.	Is Mutans Streptococci count a risk predictor of Early Childhood Caries? A systematic review and meta-analysis.	The timing of infection of a child's mouth by cryogenic bacteria-especially Streptococcus Mutans - is an important determinant of caries risk in children.
Xiao J, et al.	Prenatal Oral Health Care and Early Childhood Caries Prevention: A Systematic Review and Meta-Analysis	Covering pregnant women with dental care reduces the risk of developing ECC.
da Silva Bastos Vde A, et al.	Mother-to-child transmission of Streptococcus mutans: a systematic review and meta-analysis.	Vertical transmission of cryogenic bacteria from mother to child has been proven.
Manchanda S, Sardana D, Liu P, Lee GHM, Lo ECM, Yiu CKY. Horizontal	Transmission of <i>Streptococcus mutans</i> in Children and its Association with Dental Caries: A Systematic Review and Meta-Analysis.	Horizontal infectivity with cariogenic bacteria between children has been proven.
Chibinski AC, Wambier LM, Feltrin J, Loguercio AD, Wambier DS, Reis A.	Silver Diamine Fluoride Has Efficacy in Controlling Caries Progression in Primary Teeth: A Systematic Review and Meta-Analysis.	The widespread use of fluoride brings a definite improvement in oral health in the context of DMFT
Crystal YO, Chaffee BW.	Silver Diamine Fluoride is Effective in Arresting Caries Lesions in Primary Teeth.	SDF increased the effectiveness of caries control and inhibition by as much as 89% compared to other active ingredients
Zaffarano L, et al. Silver	Diamine Fluoride (SDF) Efficacy in Arresting Cavitated Caries Lesions in Primary Molars: A Systematic Review and Metanalysis.	SDF shows effectiveness in inhibiting active carious lesions with tooth tissue loss
Bonifácio CC, Hesse D.	Is silver diammine fluoride effective in arresting dental caries in cavitated primary molars?	SDF shows effectiveness in inhibiting active carious lesions with tooth tissue loss
Arrow P, Forrest H, Piggott S.	Minimally Invasive Dentistry: Parent/Carer Perspectives on Atraumatic Restorative Treatments and Dental General Anesthesia to the Management of Early Childhood Caries.	SDF is extremely important method of non-invasive ECC treatment, which should be considered especially in situations where children's cooperation does not allow invasive dental treatment.
Walsh T, Worthington HV, Glenny AM, Appelbe P, Marinho VC, Shi X.	Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents.	Effect of fluoride compounds is dose-dependent, and its effect of protecting teeth from caries increases with increasing dosage.
Gupta A, Sharda S, Nishant, Shafiq N, Kumar A, Goyal A.	Topical fluoride-antibacterial agent combined therapy versus topical fluoride monotherapy in preventing dental caries: a systematic review and meta-analysis.	Mixed fluoride-antibacterial therapies show higher caries arresting results than topical fluoride monotherapy.
Sharda S, Gupta A, Goyal A, Gauba K.	Remineralization potential and caries preventive efficacy of CPP-ACP/ Xylitol/Ozone/Bioactive glass and topical fluoride combined therapy versus fluoride mono-therapy - a systematic review and meta-analysis.	Mixed fluoride-antibacterial therapies show higher caries arresting results than topical fluoride monotherapy.
de Sousa FSO, Dos Santos APP, Nadanovsky P, Hujoel P, Cunha-Cruz J, de Oliveira BH.	Fluoride Varnish and Dental Caries in Preschoolers: A Systematic Review and Meta-Analysis.	Children who were receiving fluoride varnish were less likely to develop new caries lesions by 12% in comparison to not treated children.

Marinho VC, Worthington HV, Walsh T, Clarkson JE.	Fluoride varnishes for preventing dental caries in children and adolescents.	Due to the easy access and use of fluoridation gels, many countries have created preventive programs carried out in schools due to the high rate of caries prevention in children.
Rashed T, Alkhalefa N, Adam A, AlKheraif A.	Pit and Fissure Sealant versus Fluoride Varnish for the Prevention of Dental Caries in School Children: A Systematic Review and Meta-Analysis.	No difference in effectiveness of fissure sealants and fluoridation has been shown between these methods, with fluoridation being cheaper and easier to carry out.
Li F, Jiang P, Yu F, Li C, Wu S, Zou J, Xu X, Ye L, Zhou X, Zheng L.	Comparison between Fissure Sealant and Fluoride Varnish on Caries Prevention for First Permanent Molars: a Systematic Review and Meta-analysis.	No difference in effectiveness of fissure sealants and fluoridation has been shown between these methods, with fluoridation being cheaper and easier to carry out.
Manchanda S, et al.	Topical fluoride to prevent early childhood caries: Systematic review with network meta-analysis.	It was investigated what is the most optimal frequency of tooth fluoridation in terms of best protection against tooth decay - this is the use of 0.9% difluorosilane at 3-month intervals, or 5% sodium fluoride varnish at 6-month intervals, with the former prevailing in effectiveness.
Urquhart O, Tampi MP, Pilcher L, Slayton RL, Araujo MWB, Fontana M, Guzmán-Armstrong S, Nascimento MM, Nový BB, Tinanoff N, Weyant RJ, Wolff MS, Young DA, Zero DT, Brignardello-Petersen R, Banfield L, Parikh A, Joshi G, Carrasco-Labra A.	Nonrestorative Treatments for Caries: Systematic Review and Network Meta-analysis.	5% sodium fluoride is shown to be effective in treating by halting and /or remineralizing non-cavitated caries lesions
Sonesson M, Twetman S.	Prevention of white spot lesions with fluoride varnish during orthodontic treatment with fixed appliances: a systematic review	5% sodium fluoride is shown to be effective in preventing of white spot lesions during orthodontic treatment.
Benson PE, Parkin N, Dyer F, Millett DT, Germain P.	Fluorides for preventing early tooth decay (demineralised lesions) during fixed brace treatment.	5% sodium fluoride is shown to be effective in preventing of white spot lesions during orthodontic treatment
da Silva BM, Rios D, Foratori-Junior GA, Magalhães AC, Buzalaf MAR, Peres SCS, Honório HM.	Effect of fluoride group on dental erosion associated or not with abrasion in human enamel: A systematic review with network metanalysis.	Fluoride compounds (stannous fluoride and titanium tetrafluoride) can prevent erosion and abrasion.
Konradsson K, Lingström P, Emilson CG, Johannsen G, Ramberg P, Johannsen A.	Stabilized stannous fluoride dentifrice in relation to dental caries, dental erosion and dentin hypersensitivity: A systematic review.	Fluoride compounds (stannous fluoride and titanium tetrafluoride) can prevent erosion and abrasion.
Iheozor-Ejiofor Z, et al.	Water fluoridation for the prevention of dental caries.	In addition to topical agents, fluoride delivery can also be increased by, for example, water fluoridation, which reduces the level of dmft by 1.81, and DMFT by 1.16
Tubert-Jeannin S, Auclair C, Amsallem E, Tramini P, Gerbaud L, Ruffieux C, Schulte AG, Koch MJ, Rège-Walther M, Ismail A.	Fluoride supplements (tablets, drops, lozenges or chewing gums) for preventing dental caries in children.	Fluoride supplements are affiliated with reducing caries in permanent teeth comparing to non-fluoride group but studies about milky teeth were unclear.

DISCUSSION

The timing of infection of a child's mouth by cryogenic bacteria-especially *Streptococcus Mutans* - is an important determinant of caries risk in children.^{5,6} Covering pregnant women with dental care reduces the prevalence of cryogenic

bacteria in the baby's mouth, as well as the risk of developing ECC.⁷ Vertical transmission of cryogenic bacteria from mother to child has been proven.⁸ In addition to infection from the mother, horizontal infectivity with cariogenic bacteria between children has also been proven.⁹ The widespread use of fluoride brings a definite improvement in oral health in the

context of decay/missing/filled tooth (DMFT) - the use of silver diamine fluoride (SDF) increased the effectiveness of caries control and inhibition by as much as 89% compared to other active ingredients and placebo in a 12-month study of children.^{10,11} In addition, SDF shows effectiveness in inhibiting active carious lesions with tooth tissue loss (the study was conducted on first molars) by 38% when applied once or twice a year.^{12,13} This is an extremely important method of non-invasive ECC treatment, which should be considered especially in situations where children's cooperation does not allow invasive dental treatment.¹⁴ It should be noted that the effect of fluoride compounds is dose-dependent, and its effect of protecting teeth from caries increases with increasing dosage. Pastes containing 1000/ 1055/ 1100/ 1250 ppm (parts per million) reduce the caries lesion gain (prevention fraction) by 23% compared to placebo, but pastes containing 2400/ 2500/ 2800 ppm have a prevention fraction of 36%. In addition, it should be noted that at concentrations of 440/ 500/ 550 ppm, there was no difference in the protection of tooth tissue against caries compared to placebo.¹⁵ Mixed fluoride-antibacterial (xylitol/triclosan/ povidone iodine/ chlorhexidine/ cetylpyridinium chloride) therapies show higher caries arresting results than topical fluoride monotherapy.^{16,17} Children who were receiving fluoride varnish were less likely to develop new caries lesions by 12% in comparison to not treated children.¹⁸ Due to the easy access and use of fluoridation gels, many countries have created preventive programs carried out in schools due to the high rate of caries prevention in children.¹⁹ Fissure sealant (pits and fissure sealant) is another method of preventing childhood caries, but no difference in effectiveness has been shown between these methods, with fluoridation being cheaper and easier to carry out.^{20,21} It was investigated what is the most optimal frequency of tooth fluoridation in terms of best protection against tooth decay - this is the use of 0.9% difluorosilane at 3-month intervals, or 5% sodium fluoride varnish at 6-month intervals, with the former prevailing in effectiveness.²² Additionally 5% sodium fluoride is shown to be effective in treating by halting and/or remineralizing non-cavitated caries lesions²³ and in preventing of white spot lesions during orthodontic treatment.^{24,25} It was confirmed that fluoride compounds (stannous fluoride and titanium tetrafluoride) can prevent erosion and abrasion.^{26,27} In addition to topical agents, fluoride delivery can also be increased by, for example, water fluoridation, which reduces the level of DMFT (decay/missing/filled tooth - primary dentition) by 1.81, and DMFT (decay/missing/filled tooth - secondary dentition) by 1.16, however, this method has a number of most importantly limitation such as, the overall level of fluoride absorbed by the population is difficult to determine, and additional use of fluoride-containing toothpastes, dental habits, and other existing fluoride programs must then be verified to determine the overall level of fluoride absorbed.²⁸ There are studies suggesting that fluoride supplements are affiliated

with reducing caries in permanent teeth comparing to non-fluoride group but studies about milky teeth were unclear.²⁹

CONCLUSION

The use of fluoride prophylaxis highly reduces the development of caries in children, as well as inhibits its progression, and can be used supportively as a non-invasive treatment method in uncooperative children. This is extremely important from the point of view of prevention and reducing the difficulty of treatment, its cost, the potentially possible loss of teeth in the future and the limitation of living in complete comfort. The availability of fluoride compounds in toothpastes, as well as agents such as varnishes or gels that can be used widely in schools, for example, has a high potential for reducing the incidence of ECC, but the dental care of pregnant women should also be considered to reduce the transmission of cogenic bacteria into the child's mouth at an early stage of development to reduce the risk of developing it. Covering all children with prophylaxis and reducing the incidence of ECC will also potentially reduce horizontal transmission between them.

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