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Original Article

EFFECT OF AN INTERVENTION IN DECREASING OF THE PERCEPTION OF BARRIERS FOR BICYCLE USE IN THE COMMUTING TO WORK

EFEITO DE UMA INTERVENÇÃO NA REDUÇÃO DA PERCEPÇÃO DE BARREIRAS PARA O USO DE BICICLETA NO DESLOCAMENTO AO TRABALHO

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RESUMO

Esse estudo investigou o efeito de uma intervenção na percepção de barreiras para o uso de bicicleta no deslocamento ao trabalho de industriários. Participaram 876 homens (idade média = 35,4 ± 9,5 anos) de uma empresa metalomecânica. A amostra foi randomizada em grupo controle e intervenção (438 participantes em cada grupo), considerando o uso ou não da bicicleta ao trabalho. A intervenção contou com 23 encontros de 30 minutos cada ao longo de seis meses, baseados no Modelo Transteórico de Mudança de Comportamento (MTMC). A percepção de barreira para uso de bicicleta foi avaliada por meio da "escala de percepção de barreiras para o uso de bicicleta". Para análise foi aplicada estatística descritiva, qui-quadrado, teste de Wilcoxon, Kruskal-Wallis e Mann-Whitney adotando $p < 0,05$. Houve redução estatística na média da percepção de barreiras para uso de bicicleta no grupo intervenção ($Z=-2,218$; $p=0,027$). Quando estratificado por faixa etária, observou-se maior eficácia da intervenção na redução da percepção de barreiras em indivíduos na faixa etária de 30-39 anos ($Z=-2,637$; $p=0,008$). Para as demais faixas etárias, não houveram diferenças significativas. Conclui-se que intervenções baseadas no MTMC são eficazes na redução da percepção de barreiras para o uso da bicicleta para o deslocamento ao trabalho.

Palavras-chave: Bicicleta. Intervenção. Longitudinal. Adultos. Saúde.

ABSTRACT

This study investigated the effect of an intervention on perceptions of barriers for the bicycle use in commuting to work by industrialists. 876 men (mean age = 35.4 ± 9.5 years) from a metallo-mechanical company participated. The sample was randomized into a control and intervention group (438 participants in each group) considering the use or not of the bicycle when commuting to work. The intervention had 23 meetings of approximately 30 minutes each, spread over six months, based on the Transteoric Model of Behavior Change (TMBC). The perception of barriers to bicycle use was assessed using the "scale to assess the perception of barriers to bicycle use". Descriptive statistics, chi-square, Wilcoxon test, Kruskal-Wallis and Mann-Whitney were applied for analysis, adopting $p < 0.05$. There was a statistical decline in perception of barriers to bicycle use in the intervention group ($Z = -2.218$; $p = 0.027$). When stratified by age group, greater effectiveness of the intervention was observed in reducing in the perception of barriers in individuals aged 30-39 years ($Z = -2.637$; $p = .008$). For the other age groups, there were no significant differences. It is concluded that interventions based on TMBC are effective to decrease the perception of barriers for bycicle use in the commuting to work.

Keywords: Bicycle. Intervention. Longitudinal. Adults. Health.

Introduction

The use of bicycles and walking as a form of active commuting has been replaced by passive modes, such as cars and motorcycles in Brazil[1,2]. This replacement process, driven by social, economic and cultural changes, engenders worrying consequences, such as the increase in environmental pollution, the occurrence of a high number of accidents and a possible reduction in physical activity concerning the commuting domain[3]. These repercussions have a direct impact in the increase of public spending on social security and health in the short and long term. Thus, the importance of public investments in urban

mobility is justified, especially for the promotion of infrastructure and educational policies that foster and encourage the active displacement of the population[4].

Regular active bicycle commuting is associated with improved physical fitness, reduced risk of diabetes, mortality and obesity, in addition to contributing to achieve the recommended levels of physical activity[5-7]. Despite this series of benefits, there are several barriers regarding the use of bicycles[8-11]. A study carried out in a city in the south of Brazil showed that some aspects, such as unfavorable weather, lack of cycle paths, lack of traffic safety, fear of accidents and unwillingness are significant barriers with regard to the use of bicycles[10].

Recognizing the health benefits of bicycle commuting, educational campaigns and activities in order to promote changes in the population's behavior in favor of using the bicycle as a way of commuting have been proposed[12]. The Transtheorical Model of Behavior Change (TMBC) has been used in investigations with the purpose of adopting healthy behaviors, as well as for treating the types of health-related behaviors, such as smoking, alcoholism, seat belt use, weight loss, among others[13]. Although the TMBC has been used in few intervention studies[14] on bicycle-related behavior change, it is proven to be effective for this purpose[13]. A study carried out in Brazil with industrialists confirmed the promising role of this model in the sense of maintaining the use of bicycles for work commuting[15].

According to the above mentioned model, the behavior change process goes through five stages in which the individual is expected to be aware of the pros and cons of the desired behavior, in addition to improving their perception on self-efficacy and moving towards the final stages of behavior change[13]. These stages identify people according to their readiness level to adopt some behavior, that is, pre-contemplation, contemplation, preparation, action and maintenance[13]. Considering the pre-contemplation stage, the individual has no intention of changing behavior in the foreseeable future. In the contemplation stage, the person considers the need to change behavior at some point in the future. With regard to preparation, the individual makes the decision to change behavior and begin to plan a strategy for changing. During the action stage, the subject begins to take concrete actions for changing, however, not yet for more than six months. In the final stage, that is, maintenance, the individual has already adopted a certain behavior for more than six months by incorporating such a change into his/her routine[13].

Therefore, the following hypothesis is raised: during this process individuals fail to perceive barriers that previously existed and/or seek alternatives to overcome them. In this sense, the decreased perceived barriers are likely to contribute to a greater probability of behavior change, even if this has not been achieved yet. However, there are no experimental studies based on the TMBC that have investigated the relationship between the perceived barriers and behavior change and/or the effectiveness of this model in reducing these barriers.

Therefore, the present study aimed at assessing the effect of an intervention based on the Transtheorical Model of Behavior Change on the perception of bicycle-related barriers by industrialists for work commuting.

Methods

Study design and site

This is an experimental design study carried out with 932 male industrialists from a metallurgical industry in 2011. The choice for this company was intentional, since this is the largest foundry in Latin America recognized for its technological capacity[16]. The investigation was performed in the city of Joinville, Santa Catarina state (SC), the largest city in SC with an

estimated population of 515,288 inhabitants[17] and responsible for about 20% of the state's exports.

Population and sample

The study population consisted of 6259 workers (94% men). Being male and belonging to either the administrative sector or production line during working hours were defined as inclusion criteria, that is, 1st shift (5:00 am - 2:18 pm) and 2nd shift (2:18 pm - 10:23 pm). In order to calculate the sample size, a significance level of 5% was adopted, in addition to the power of the test at 80% considering a loss rate of 8%, with a minimum sample of 858 workers.

The initial sample (baseline) consisted of 932 workers, randomly allocated to the control group (n = 468) and intervention group (n = 464), considering the use or not of bicycle when commuting to work. After being invited and informed about the purposes of the study, the workers signed the Free Informed Consent Form accepting to participate in the study.

Study variables

Before the randomization process, all the workers selected answered a questionnaire to provide information on sociodemographic, health, bicycle use, and bicycle-related perceived barriers issues. Sociodemographic information were collected, that is, age (≤ 29 years; 30-39 years; ≥ 40 years), marital status (married; not married), gross family income (≤ R$ 1080,00; R$ 1080,01 - R$ 2700,00; ≥ R$ 2700,01), education level (≤ 8 years; 9-11 years; ≥12 years of study), and distance from work (≤ 5km;> 5km). Bicycle commuting was evaluated based on how the individuals commuted to work, thus, those who used to cycle to work and had a bicycle were identified. Moreover, the Transtheorical Model of Behavior Change was applied to identify the stages of behavior change[13], which were categorized into pre-contemplation, contemplation, preparation, action and maintenance.

The Perception of Barriers scale was used in order to assess the perceived bicycle-related barriers[18]. This instrument included questions on the potential barriers referring to the use of bicycles for work commuting. The participant could tick (yes; no) for each question, besides indicating if that was configured as a barrier for them to commute by bicycle. Through a scale reliability analysis, a block of seven barriers (Cronbach's alpha = 0.897) was used so as the investigation was carried out. Such a block consisted of the following barriers: lack of safety, poor quality of the streets, lack of cycle paths, heavy traffic, unfavorable weather, distance from work and fear of accidents.

Data collection and intervention were coordinated by the research team members, that is, a Physical Education professional and an intern in the same area. These were held in the industry during the industrialists' working hours.

Intervention

The educational intervention was structured based on the Transtheoretical Model of Behavior Change and has previously been published[15]. The intervention group (IG) was subdivided into 16 groups as follows: eight groups included people who did not use to cycle, that is, they were in the stages of pre-contemplation (do not cycle, and do not intend to cycle in the next six months), contemplation (do not cycle, but intend to cycle in the next six months) or preparation (do not cycle, but intend to cycle in the next 30 days). The other eight groups included people who had been already commuting to work by bicycle, thus, they were in the action phase (have been cycling for less than six months), and maintenance (have been

cycling for more than six months). The intervention was performed for six months with a 30-minute-weekly meeting, thus, a total of 23 meetings, in which contents on benefits that cycling brings to health and the environment were discussed, as well as safety to cycle by applying interactive activities, such as lectures, videos, games, etc[15]. The subjects in the control group (CG) were provided with health education by discussing topics on nutrition, workplace ergonomics and preventive behavior. These activities included three meetings of 30 minutes each distributed during the study.

Data processing and analysis

The data collected were typed based on the optical reading of the questionnaires by using the Sphynx Software Solution Incorporation program, and, then, manually verified and transported to the statistical program SPSS version 25.0. Considering the data analysis separated per groups, descriptive statistics was applied, in addition to using chi-squared, Wilcoxon, Kruskal-Wallis and Mann-Whitney tests; $p < 0.05$ was adopted.

Ethical procedures

All the procedures used in the study were approved by the Research Ethics Committee of the State University of Santa Catarina (protocol 1160/10).

Results

876 male industrialists (mean age 35.39 ± SD 9.52) from a metallurgical industry in Joinville, Santa Catarina, participated in the study. From the initial sample, 56 subjects did not finish the study, thus, there was a total loss rate of 6.0%. Most industrial workers were married (78.3%), had attended school for 9-11 years (65.4%), had a gross family income from R$ 1080.01 to R$ 2700.00 (53.5%), lived ≤ 5km away from the industry (54.2%), had a bicycle (72.3%) and did not use to cycle to work (55.7%). The distribution of the sample between the control and intervention groups did not show a statistical difference, except for education ($p = 0.023$) and gross family income ($p = 0.001$).

Table 1. Distribution of the sample according to the sociodemographic and behavioral characteristics of the baseline industrialists. Joinville, Santa Catarina, Brazil, 2011 (n = 876)

Variables		CG (n=438)		IG (n=438)		Total (n=876)		
		n	%	n	%	n	%	p^a
Age (years)								0.220
	≤ 29	151	34.5	136	31.0	287	32.7	
	30-39	153	34.9	144	32.9	297	33.90	
	≥ 40	134	30.6	158	36.1	292	33.3	
Marital status								0.566
	Married	347	79.2	339	77.4	686	78.3	
	Not married	91	20.8	99	22.6	190	21.7	
Education level (years)								0.023*
	≤ 8 years	52	11.9	76	17.3	128	14.6	
	9-11 years	287	65.5	286	65.4	573	65.4	
	≥ 12 years	99	22.6	76	17.3	175	20.0	
Gross Family Income (R$)								0.001*
	≤ R$ 1080,00	49	11.3	73	16.7	122	14.0	
	R$1080,01 - 2700,00	222	50.9	246	56.2	468	53.5	
	≥ R$ 2700,01	165	37.8	119	27.1	284	32.5	
Work shift								0.858
	1st shift (5:00 a.m. -2:18 p.m.)	194	44.3	197	45.0	391	44.6	
	2nd shift (2:18 a.m.- 10:23 p.m.)	171	39.0	174	39.7	345	39.4	
	Working hours (7:30 a.m. - 5:00 p.m.)	73	16.7	67	15.3	140	16.0	
Use of bicycle for work commuting								0.815
	Yes	192	43.8	196	44.7	388	44.3	
	No	246	56.2	241	55.3	487	55.7	
Distance from work								0.342
	≤ 5km	245	55.9	230	52.5	475	54.2	
	> 5km	193	44.1	208	47.5	401	45.8	
Having a bicycle								1,000
	Yes	316	72.2	317	72.4	633	72.3	
	No	122	27.8	121	27.6	243	27.7	

Note: [a] chi-squared test between the control and intervention groups; *statistical difference
Source: The authors

The means related to the perception of bicycle-related barriers for work commuting in the IG decreased (Z = -2.218; p = 0.027) after the intervention. No statistical difference was identified between the control and intervention groups before and after the intervention in relation to the means of the barriers (Figure 1).

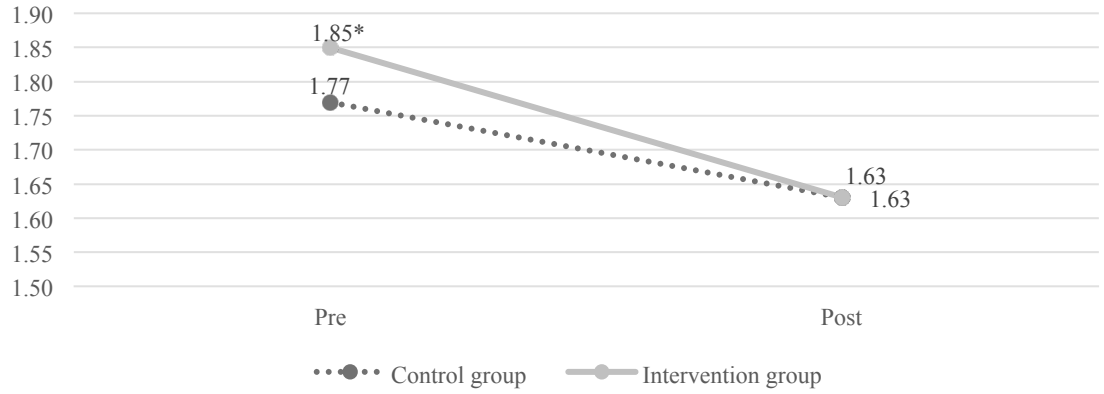

Figure 1. Means related to the industrialists' perception of bicycle-related barriers for work commuting in the pre and post intervention periods in the control and intervention groups. Joinville, Santa Catarina, Brazil, 2011 (n = 876)

Note: *Statistical difference
Source: The authors

The analyzes stratified per shifts and distance from work did not show statistical difference after the intervention, however, when seen per age group, in the IG, the 30-39-year-old individuals showed greater perception of bicycle-related barriers for work commuting, that is, less than the baseline number of barriers (Z = -2.637; p = 0.008). Considering the other age groups in the intervention and control groups, there were no significant differences (Table 2).

Table 2. Comparison of the industrialists' perception of bicycle-related barriers for work commuting according to age group, shift and distance from work in the baseline and follow-up. Joinville, Santa Catarina, Brazil, 2011 (n = 876)

Variables	Collection period for the perceived barriers		*p**
	Before (n = 438)	After (n = 438)	
	Mean ± sd	Mean ± sd	
Age (years)			
≤ 29	2.0 ± 2.3	1.8 ± 2.4	0.540
30-39	1.7 ± 2.5	1.3 ± 2.1	0.008[a]
≥ 40	1.9 ± 2.5	1.8 ± 2.5	0.436
p**	0.301	0.104	
Shift			
1st shift (5:00 a.m. – 2:18 p.m.)	1.5 ± 2.2	1.3 ± 2.0	0.133
2nd shift (2:18 p.m. – 10:23 p.m.)	2.0 ± 2.6	1.9 ± 2.5	0.315
Working hours (7:30 a.m. – 5:00 p.m.)	2.6 ± 2.6	2.2 ± 2.5	0.150
p**	0.007[b]	0.027[b]	
Distance from work			
≤ 5km	1.0 ± 1.9	0.8 ± 1.7	0.068
> 5km	2.8 ± 2.6	2.6 ± 2.6	0.157
p***	< 0.001[b]	< 0.001[b]	

Note: *Wilcoxon test; [a]statistical difference before and after the test; **Kruskal-Wallis test; ***Mann-Whitney test; [b] statistical difference between the categories
Source: the authors

Discussion

The results of this study showed that the intervention based on the principles of the Transtheoretical Model of Behavior Change was effective in reducing the industrialists' perception of bicycle-related barriers for work commuting, especially regarding 30-39-year-old individuals. Similar studies that focus on reducing the perception of barriers are still scarce, despite the significance of this theoretical model for promoting physical activity[19]. Understanding the mechanisms that may explain the use of bicycles for work commuting is important in order to increase this behavior at population levels. The intervention strategies reflected on the decreased perception of bicycle-related barriers. However, interventions that evaluate other issues, such as the environment built, might also be significant to reduce the perception of these barriers, for example, the presence of a bicycle path network, traffic speed control, number of destinations of interest, among others[20]. This shall be fundamental for greater effectiveness of educational interventions.

The intervention group showed a decreased perception of bicycle-related barriers. This result was similar to that reported in an investigation on sedentary workers from a telecommunications company. Such workers showed a decreased perception of barriers regarding physical exercise after an intervention based on the Transtheoretical Model of Behavior Change[21]. In addition, a positive relationship between greater self-efficacy for physical activity and the stages of behavior change was seen, as well as a decreased perception of internal and external barriers[22]. Therefore, it is believed that the intervention influenced the perception on individual experiences and skills regarding bicycle use. This led to a new meaning of the perceived barriers, since the intervention was performed based on contents related to the benefits that bicycle commuting brings to health and the environment, in addition to providing information on how to use the bicycle safely. These contents may have brought greater knowledge to individuals, thus, improving self-confidence, especially for people who were in the initial stages of behavior change, which resulted in a decreased perception of barriers. This reinforces the significance of inserting educational processes to promote bicycle use, both by people who are in the action and maintenance phases and by those who are in the initial phases.

The middle-aged intervention group individuals (between 30 and 39 years of age) showed a greater reduction in the perception of bicycle-related barriers for work commuting. No records were found in the literature that explain or show similarities in relation to this 30-39-year-old individuals' sensitivity with regard to the reduced barriers. There is a relationship between age and perception of barriers, in the sense that older individuals tend to have greater barriers regarding the practice of physical activity[23]. It is believed that the intervention had no effect on the younger group due to the fact that most of the individuals have already been commuting by bicycle, besides having a lower number of barriers. Therefore, broader changes, such as improving the quality of bike paths, having a better place to park the bicycle, and a place to bathe, are likely to provide a better effect on this group than just the knowledge shared in the intervention. On the other hand, considering the older individuals, it is believed that the high number of barriers and the low motivation to start a new behavior make this process much more complex and demand more investment so that such a change occurs. Thus, the middle-aged men were the most sensitive individuals to the intervention, possibly because they still understand that changing and making such a change is necessary and possible.

Regarding the interpretation of the results some limitations should be considered. The specificity of the population is likely to have limited the external validity of the study[15], since it is an analysis on workers from only one industry in a city that has infrastructure, such as bicycle paths, thus, these issues should be considered when facing other realities. The very

representative sample size and the low loss rate in the follow-up are considered strengths of the study. In addition, the randomized experimental study enabled the comparison between the control and intervention groups. Finally, the strategies adopted in the present study can be implemented in other industries. The movement in the sense of replacing active modes by passive modes, such as cars and motorcycles, resulted in an increased environmental pollution and a high number of accidents. In this sense, the present study validates the promising role of the Transtheoretical Model of Behavior Change in reducing bicycle-related barriers for work commuting, in addition to maintaining this behavior by those who already used to do it[15].

Conclusions

The intervention had a positive effect on reducing the industrialists' perception of bicycle-related barriers for work commuting, specifically regarding the 30-39-year-old individuals. However, the causes that may justify this finding are little explored. Therefore, further studies that investigate the effectiveness of the Transtheoretical Model of Behavior Change in certain age groups are recommended in order to verify whether this sensitivity is repeated in other populations or is limited to the intervention design carried out in the present study. It is also suggested that in addition to the educational intervention based on the TMBC, other theoretical models, such as the Self-Determination Theory, the Social Cognitive Theory and Social Ecological Model are used in order to consider different elements besides knowledge on the use of bicycle.

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