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Original Research Article

Car Seat Comfort by Measuring Interface Pressure and Using Subjective Evaluation System in Road Trials

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Abstract

This study assesses automobile seat comfort by using a subjective evaluation system with road trials and by measuring seat pressure. The focus of this study is to demonstrate how drivers are affected by seat comfort under actual road conditions. All experiments were carried out with 55 participants driving for at least 2.5 h. Before the participants drove, the interface pressure was measured at 9 areas in the automobile.During the road trials, a comfort assessment was performed at 4 intervals: 0 min, 15 min, 75 min and 150 min. Participants were required to complete a questionnaire of 24 questions for each section. In total, 33 parameters were evaluated using related statistical techniques with SPSS. The participants felt discomfort after 75 minutes, and seat comfort was directly affected by thermal comfort parameters. However, overweight participants found the seat to be more comfortable than subjects with a normal BMI. Evaluating during road trials is difficult, but real traffic conditions affect comfort level. In future studies, real traffic situations should not be omitted when assessing comfort. This study will help to close the information gap in this area because comfort was evaluated on the road for at least 2.5 hours with subjective evaluation system.

Keywords: Car seat comfort, driving comfort, road trials, interface pressure measurement

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1. Introduction

Comfort integrates a sense of well-being with health and safety; conversely, discomfort appears to be primarily related to biomechanical factors (Zhang et al., 1996) involving muscular and skeletal systems (Andreoni G., Santambrogio C., Rabuffettib M., Pedotti A., 2002). In common parlance, comfort may refer to both comfort and discomfort. In particular, the term 'comfort' is associated with feelings of relaxation, well-being, satisfaction, aesthetics and luxury (Bubb, 2003). While 'comfort' is connected with aspects of 'favor,' the term 'discomfort' relates to aspects of 'suffering.' Discomfort is more associated with biomechanical factors that produce feelings of pain, numbness and stiffness. These feelings increase with time on task and fatigue (Zhang et al., 1996).

Comfort is a very important parameter for automobile seat design. There are many factors that affect automobile seat comfort; user subjectivity, occupant anthropometry, seat geometry, and the amount of time spent sitting have previously been cited (Thakurta et al., 1995). Automobile seat comfort can be evaluated in two areas: static comfort and dynamic comfort. `Static comfort' refers to the impressions of seated occupants when there is no vibration. Static seat characteristics such as the shape, size and hardness are thought to affect static comfort. Dynamic comfort' refers to the impressions of seated occupants while exposed to vibration and is related to the vibration transferred through the seat to the occupants (Ebe and Griffin, 2001). Both types should be considered when designing automobile seats.

The aim of this study was to conduct an assessment of seat comfort on the road conditions with actual customers. While comfort was evaluated both statically and dynamically, parameters were also investigated that affected seat comfort for new car seat designs. Although there are many studies in this area, this study offers distinct parameters:

- The samples are crowded (n=55) and different in terms of age/weight/height range.
- The participants were randomly selected from actual customers.
- There are more subjective evaluation parameters than previous studies (24 subjective parameters and 9 pressure parameters were evaluated).

The driving trial time was at least 2.5 hours. This is the longest road trial in this area.

2. Method

2.1. Participant Selection

The subjects were actual customers randomly chosen from residents living in Bursa to provide insight into customer expectations. Knowing actual expectations can provide more suitable designs. The participants were required to have the following:

- A driving license for at least six months,
- A daily driving experience of at least 30 min. a day,
- Good health, with no muscular/skeletal system problems in the last 6 months.
- A sample of 55 male customers with different BMIs and a wide range of ages were chosen. The characteristics of the participants are shown in Table 1.

Table 1. The characteristics of the 55 participants

	Mean	Minimum	Maximum
Age (years)	40	26	60
Height (m)	1.77	1.62	1.90
Weight (kg)	79	60	100
Body mass index (kg/m^2)	25.39	20.34	30.80

2.2. Road Trials

The road trials were performed by the participants in a Fiat Linea during springtime in Turkey. Each participant drove at the same time of the day to standardize the road traffic and air conditions. The trials began at 10:00 AM to minimize driver fatigue or nervousness. Before the participants began the experiments, they were briefed on the general purpose of the experiment, the pressure mats, the subjective questionnaires, etc.

The route of road trials included the different road types in Bursa such as urban, mountain, suburban and highways. The road tests involved driving a distance of approximately 123 km and lasted for at least 2.5 hours (Table2).

Table 2. Road types

Road type	Urban	Mountain	Highway	Suburban	Total
Road (km)	27.8	9.4	51.5	34.3	123
Road (%)	22.6	7.6	42.0	27.8	100

During the road trials, comfort assessments were performed at 4 times: 0min, 15 min, 75min and 150min. Drivers gave a rating for the individual questions in the questionnaire by entering a whole number from 1 to 10. The assessment of static/dynamic seat comfort included ratings on the overall seat, the cushion, the backrest and the head rest. All 24 questions and subjective questionnaire scales from 1 to 10 are provided in Appendix 1.

Before the trial began, the participants adjusted the seat to their usual driving position, e.g., height and tilt adjustment for the cushion, tilt and lumbar support adjustment for the backrest, etc. Drivers also adjusted the climate functions (heat and ventilation) as desired. If the drivers experienced discomfort, pain or fatigue, they could adjust the seat when they stopped the automobile. However, during the performing assessment of comfort the drivers were not permitted to get out of the automobile. Customer expectations were noted in the questionnaire at the end of the test.

2.3. Pressure Measurement

Pressure measurement was performed using an X-Sensor Pro mat. The system provides professional software, a sensor pack, a USB cable and a universal power supply. Two mats were used for the study, one on the cushion and one on the backrest. Pressure measurement mats had 1296 sensors and the total sensor area was 45 cmx45 cm (Figure 1).

Before the road trials, the automobile was parked in the laboratory to measure the participant-automobile seat interface. The drivers removed any items in their pockets (wallet, keys, etc.) to enable correct pressure data readings. They were seated after the mats were placed. Participants were measured in their usual driving position (with their hands on the steering wheel and looking ahead, their left foot on the footrest, and their right foot on the gas pedal) for 3 min to record the data. The participants then adjusted their seat to their usual driving position and recording began.

Figure 1. Pressure mat

2.4. Data Analysis

All parameters were defined as two groups using SPSS 20.00 seat comfort assessment variables (Table 3) and pressure variables (Table 4).

A normality test was first applied for all parameters. According to the result of this test, the parameters were divided into 2 categories: normally distributed and non-normally distributed.

A Wilcoxon T Test was used for dependent samples in which the data were collected in matched pairs. This test is the non-parametric version of a paired samples t-test. The data distributions do not need to follow the normal distribution. The Wilcox on T test was used to determine whether there was a difference between the scores at the beginning and the end of the tests.

The Independent-Samples T Test procedure compares the means for two groups of cases. Ideally, the subjects should be randomly assigned to two groups for this test so that any difference in response is due to the treatment (or lack of treatment) and not to other factors.

Table 3.Seat comfort assessment variables

Parameter code	Parameter
S1	Seat comfort/discomfort
S2	Seat stiffness/softness
S3	Seat lateral containment
S4	Cushion comfort/discomfort
S5	Cushion stiffness/softness
S6	Cushion lateral containment
S7	Thigh front support
S8	Cushion longitudinal containment
S9	Cushion performance during roughness in road
S10	Cushion body area discomfort/fatigue
S11	Cushion warm/cool sensation
S12	Cushion sensation of transpirability
S13	Backrest comfort/discomfort
S14	Backrest stiffness/softness
S15	Backrest lateral containment
S16	Lumbar support
S17	Backrest performance during roughness in road
S18	Backrest body area discomfort/fatigue
S19	Backrest warm/cool sensation
S20	Backrest sensation of transpirability
S21	Headrest comfort/discomfort
S22	Headrest stiffness/softness
S23	Space between head and headrest
S24	Evaluation of seat at the end of the test

Table 4.Pressure variables

Parameter code	Parameter
P1	Seat pressure
P3	Seat lateral support pressure
P4	Cushion pressure
P6	Cushion lateral support pressure
P7	Thigh front pressure
P13	Backrest pressure
P16	Lumbar pressure
P17	Upper back pressure

The Wilcoxon-Mann Whitney U Test is a non-parametric test. Two data samples are independent if they come from distinct populations and the samples do not affect each other. This test is used to determine whether the population distributions are identical without assuming them to follow the normal distribution.

To evaluate the relationship between BMI and comfort assessment, the Independent-Samples T Test and Wilcoxon-Mann Whitney U Test were used. The Independent-Samples T Test was used for normally distributed parameters and the Wilcoxon-Mann Whitney U Test was used for non-normally distributed parameters.

The correlation between variables is a measure of how well the variables are related. The most common measure of correlation in statistics is the Pearson Correlation, which shows the linear relationship between two variables. The Spearman Correlation is a nonparametric measure of statistical dependence between two variables. Pearson correlation coefficients were calculated between parameters that both exhibited normal distribution. Spearman rank correlation coefficients were calculated between two parameters when either variable (or both) was not normally distributed.

A linear regression analysis is a statistical technique for estimating the relationships among variables. A linear regression analysis was used to evaluate the relationships between seat comfort and the other subjective comfort assessment and objective measurements.

3. Results

3.1. Normality Test

A normality test was applied for all measured parameters. According to the Shapiro-Wilk test results, S1, S4, S5, S6, S7, S11, S12, S13, S16, S18, S19, S20, S24,P3, P4, P6, P13,P15, P16 and P17 were normally distributed (p >0.05).By contrast, S2, S3, S8, S9, S10, S14, S15, S17, S21, S22, S22, P1, and P7were not normally distributed (p <0.05).

3.2. Interface Pressure Data

Using X-sensor Pro software, the max

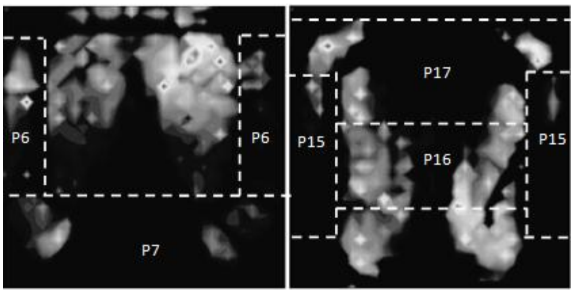
pressure, min pressure and mean pressure data were located on the pressure map (Table 5).

The seat was evaluated on both the cushion and the back rest: the cushion (a) was examined in terms of the overall cushion (P4), lateral support (P6), and thigh pressure (P7), while the back rest (b) was examined in terms of the overall back rest (P13); lateral support (P15), lumbar pressure (P16) and upper back pressure (P17) (Figure 2).

3.3. The Effect of Driving Time on Seat Comfort

The test scores were computed for all 55 participants. The Wilcoxon T test was used to determine whether there was a difference between the scores at the beginning and end of the tests.

The test statistics are shown in Table 6. According to the test results, S1, S2, S3, S4, S5, S6, S8, S9, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, and S24 were significant at 5% ($p < 0.05$).

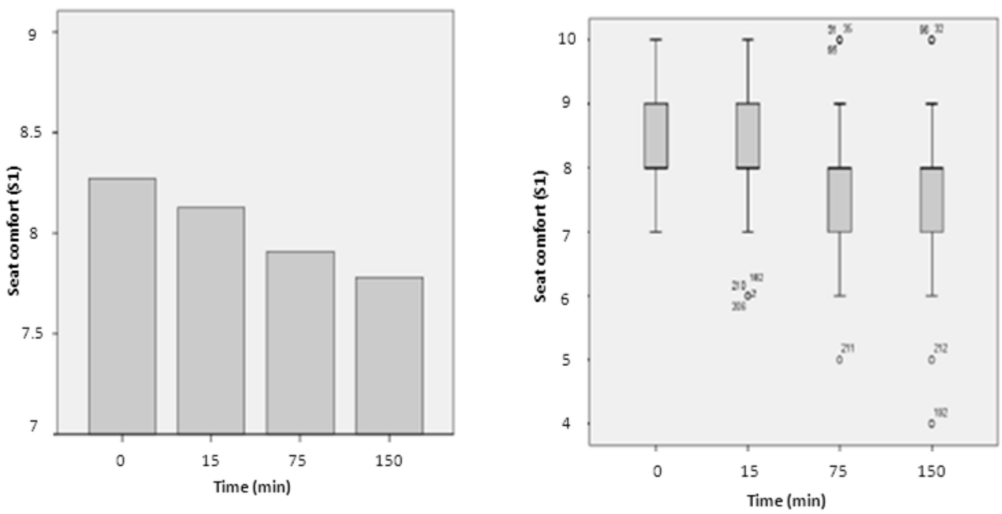


(a) **(b)**

Figure 2. Cushion (a) and backrest (b) on the pressure map

Table 5. Interface pressure data (n=55)

Parameter Code	Parameter	Mean Pressure (mmHg)	Max Pressure (mmHg)	SD	Sig.
P1	Seat pressure	31.19	43.14	4.19396	.022
P3	Seat lateral support pressure	19.56	32.85	5.96976	.550
P4	Cushion pressure	39.92	58.72	6.51888	.121
P6	Cushion lateral support pressure	26.59	48.10	7.26170	.122
P7	Thigh front pressure	15.30	25.53	4.98152	.000
P13	Backrest pressure	17.81	27.32	3.19962	.122
P15	Backrest lateral support pressure	12.52	23.53	6.69834	.105
P16	Lumbar pressure	16.70	30.80	4.72382	.077
P17	Upper back pressure	18.44	30.11	3.99052	.051



a b

Figure 3. Changing “seat comfort” (S1) parameter over time, (a) bar chart, (b) box-plot

Bar charts and box-plots are shown in Figure 3-7 for some important parameters that affect comfort level. When the results are examined, these charts present changes in the measured parameters over time. While there were no significant differences in the first 75 minutes, there was a significant change in comfort level after 75 minutes, particularly at the end of the test (at 150 min) when the comfort level declines considerably.

Table 6. Wilcoxon T test

Parameter code	Parameter	Z	Asymp. Sig. (2-tailed)
S1	Seat comfort	-3.781	.000
S2	Seat stiffness/softness	-3.227	.001
S3	Seat lateral containment	-2.694	.007
S4	Cushion comfort	-2.994	.003
S5	Cushion stiffness/softness	-3.370	.001
S6	Cushion lateral containment	-2.871	.004
S8	Cushion longitudinal containment	-6.604	.000
S9	Cushion performance in rough road	-6.625	.000
S10	Cushion body area discomfort/fatigue	-6.519	.000
S11	Cushion warm/cool sensation	-5.395	.000
S12	Cushion sensation of humidity	-5.395	.000
S13	Backrest comfort	-4.296	.000
S14	Backrest stiffness/softness	-3.733	.000
S15	Backrest lateral containment	-3.273	.001
S16	Lumbar support	-2.126	.033
S17	Backrest performance in rough road	-6.636	.033
S18	Backrest body area discomfort/fatigue	-6.498	.000
S19	Backrest warm/cool sensation	-5.870	.000
S20	Backrest sensation of humidity	-5.765	.000
S21	Headrest comfort	-.966	.334
S22	Headrest stiffness/softness	-1.890	.059
S23	Space between head and headrest	-.302	.763
S24	Evaluation of seat at the end of the test	-2.914	.004

3.4. The Parameters Affecting Seat Comfort

The Pearson correlation coefficients and the Spearman rank correlation coefficients were calculated between all parameters. For normally distributed parameters, Pearson correlations were used.

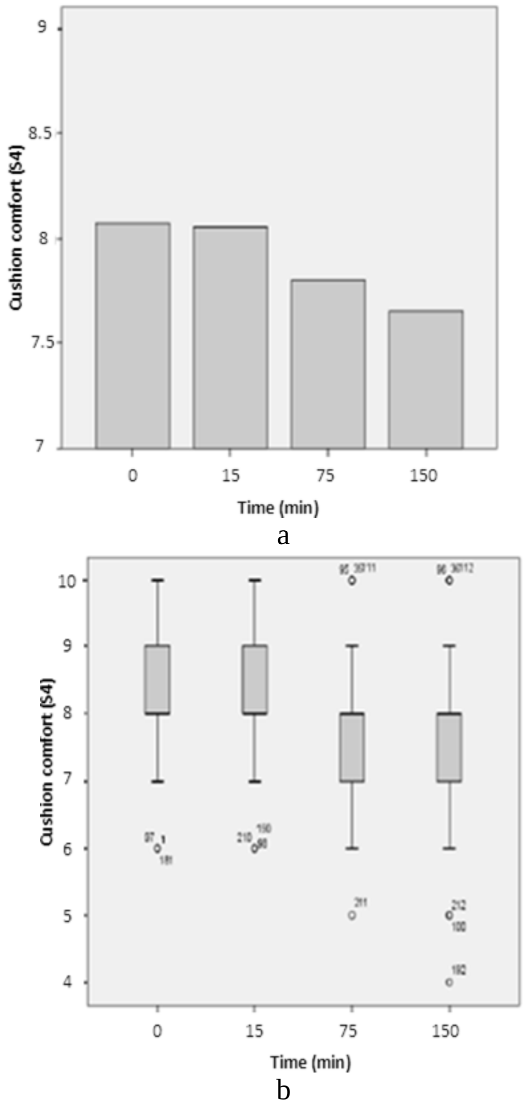
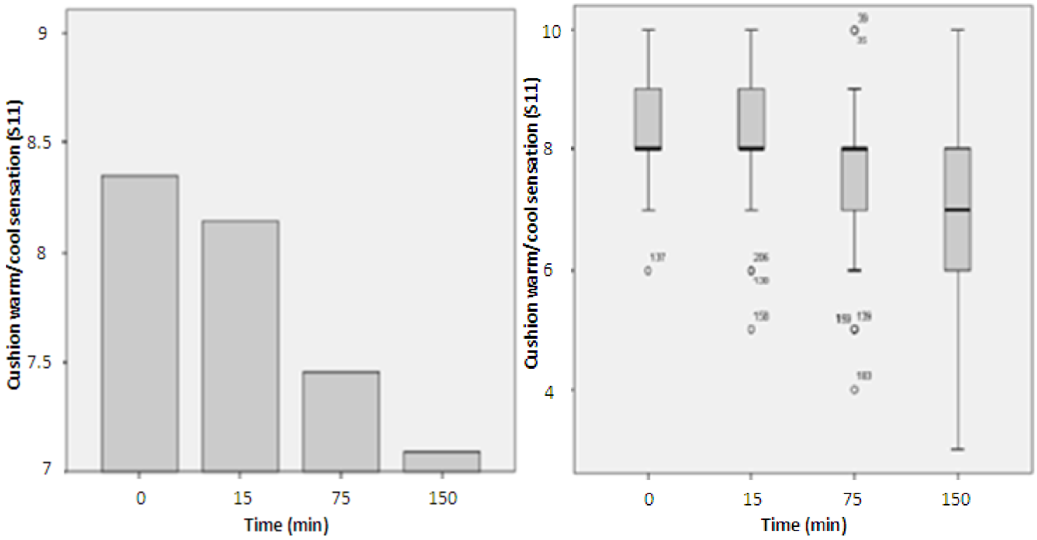


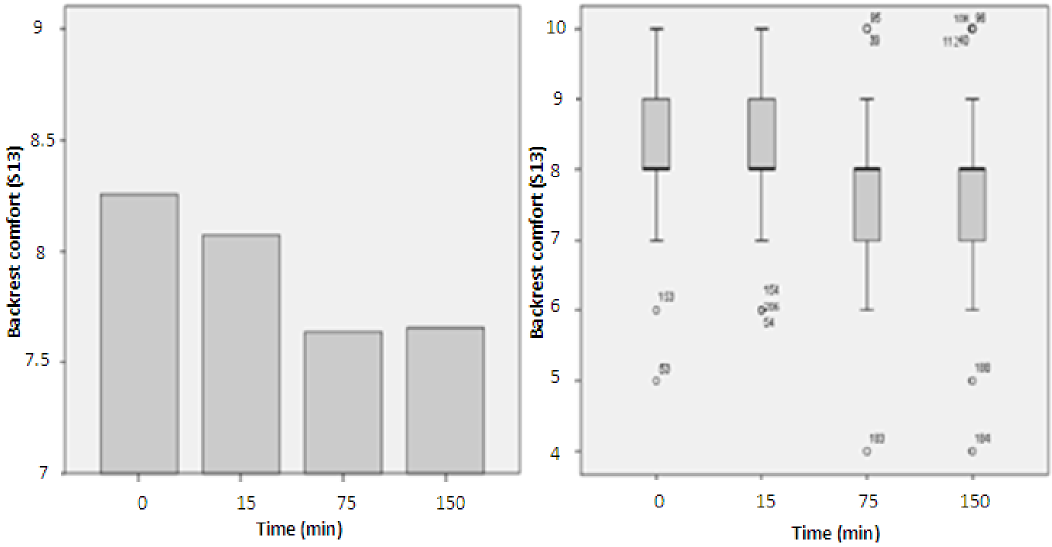
Figure 4. Changing "cushion comfort" (S4) parameter over time, (a) bar chart, (b) box-plot

For non-normally distributed parameters, Spearman correlations were used. There were many correlations with 5% significance ($p< 0.05$). In this instance, only seat comfort (S1) parameters were taken into account. It was important to determine parameters that were related to S1. Table 7 shows the parameters affecting seat comfort (S1). According to Table 7, S4, S11, S13, S12, S19, S9, S10 and S20 were very important for seat comfort.



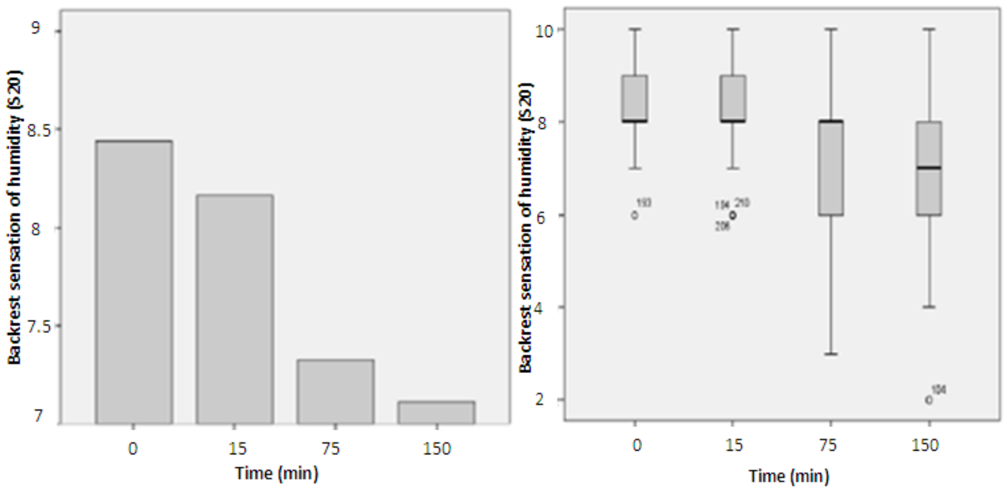
(a) (b)

Figure 5. Changing “cushion warm/cool sensation” (S11) parameter over time, (a) bar chart, (b) box-plot



(a) (b)

Figure 6. Changing “backrest comfort/discomfort” (S13) parameter over time, (a) bar chart, (b) box-plot



(a) (b)

Figure 7. Changing “backrest sensation of humidity” (S20) parameter over time, (a) bar chart, (b) box-plot

Table 7. The parameters affecting seat comfort

	Code	Parameter	Type of correlation	Correlation coefficient	p
SEAT COMFORT (S1)	S4	Cushion comfort	Pearson	0.830	0.000
	S11	Cushion warm/cool sensation	Pearson	0.796	0.000
	S13	Backrest comfort/discomfort	Pearson	0.771	0.000
	S12	Cushion sensation of humidity	Pearson	0.735	0.000
	S19	Backrest warm/cool sensation	Pearson	0.730	0.000
	S9	Cushion performance in rough road	Spearman	0.740	0.000
	S10	Cushion body area discomfort/fatigue	Spearman	0.723	0.000
	S20	Backrest sensation of humidity	Pearson	0.702	0.000

3.5. The Effect of BMI on Seat Comfort

Data were compared with respect to BMI. A BMI<=25 was defined as “normal”, and a BMI>25 was defined as “overweight”. The Independent-Samples T test was used for normally distributed parameters, and the Wilcoxon-Mann Whitney U Test was used for non-normally distributed parameters to determine whether “normal” and “overweight” participant scores for the subjective questioning parameters were different. The test statistics are shown for the Independent-Samples T test in Table 8 and the Wilcoxon-Mann Whitney U Test in Table 9. From the result of Independent-Samples T test, S1, S4, S5, S11, S12, S13, S18, S19 and S24 were significant parameters. According to Table 9, S2, S5, S6, S8, S9, S10 were significant parameters.

Figures 8-13 show some important parameters according to different BMI levels. According to these results, the overweight participants found the seat more comfortable compared to subjects with a normal BMI.

Table 8. Independent-Samples T test

Parameter							95% Confidence Interval of the Difference	
Name	Code	t	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Seat comfort	S1	-2.907	53	.005	-.64000	.22017	-1.08161	-.19839
Cushion comfort	S4	-2.782	53	.007	-.65133	.22408	-1.12085	-.18182
Cushion stiffness/softnes	S5	-2.172	51	.035	-.43902	.20211	-.84478	-.03327
Cushion lateral containtment	S6	-1.397	51	.169	-.28659	.20521	-.69857	.12538
Thigh front support	S7	-1.450	53	.153	-.46433	.32024	-1.10665	-.17798
Cushion warm/cool sensation	S11	-2.776	53	.008	-.73000	.26293	-1.25738	-.20262
Cushion sensation of humidity	S12	-2.504	53	.015	-.62667	.25022	-1.12855	-.12478
Backrest comfort	S13	-2.521	53	.015	-.59467	.23585	-1.06772	-.12161
Lumbar support	S16	-2.707	52	.094	-.48611	.28477	-1.05754	-.08532
Backrest body area discomfort/ fatigue	S18	-2.336	53	.023	-.58773	.25163	-1.09243	-.08304
Backrest warm/cool sensation	S19	-2.128	53	.038	-.60833	.28587	-1.18171	-.03496
Backrest sensation of humidity	S20	-1.780	53	.081	-.53680	.30163	-1.14179	-.06819
Evaluation of seat at the end of the test	S24	-2.956	53	.005	-.66333	.22436	-1.11335	-.21332

Table 9. Wilcoxon-Mann Whitney U Test

Parameter code	Parameter	Mann-WhitneyU	Wilcoxon W	Z	Asymp Sig.(2-tailed)
S2	Seat stiffness/softness	261.500	586.500	-1.9440	-.052
S3	Seat lateral containment	294.500	619.500	-1.9402	.161
S5	Cushion stiffness/softness	255.500	580.500	-2.0400	.041
S6	Cushion lateral containment	261.500	586.500	-1.9620	.050
S8	Cushion longitudinal containment	164.500	489.500	-3.7500	.000
S9	Cushion performance in rough road	220.500	545.500	-2.6790	.007
S10	Cushion body area discomfort/fatigue	224.000	549.000	-2.5970	.009
S21	Headrest comfort	280.000	605.000	-1.6760	.094
S22	Headrest stiffness/softness	333.500	658.500	-.7520	.452
S23	Space between head and headrest	284.500	609.500	-1.6340	.102

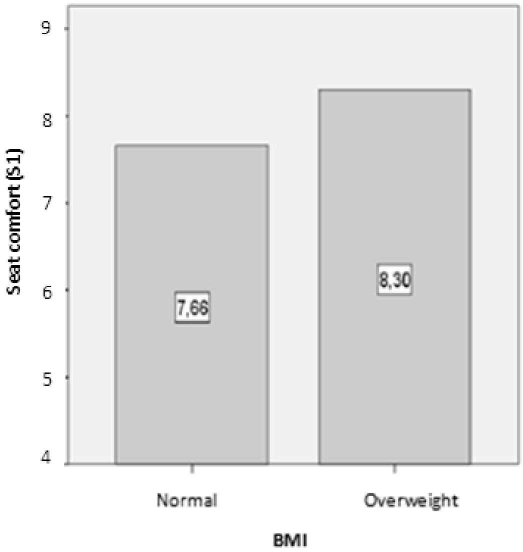


Figure 8. Mean of "Seat comfort (S1)" according to normal and overweight participants

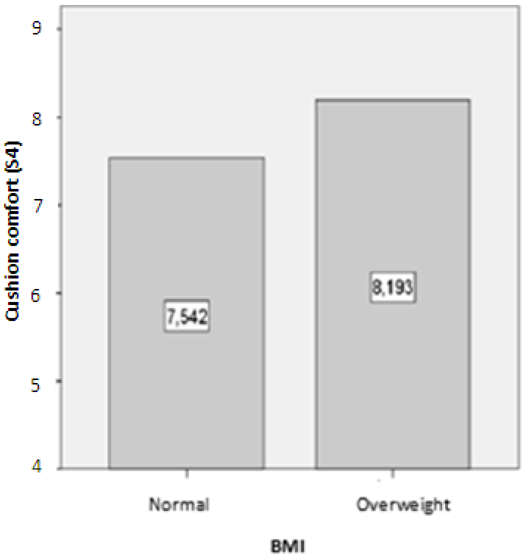


Figure 9. Mean of "Cushion comfort (S4)" according to normal and overweight participants

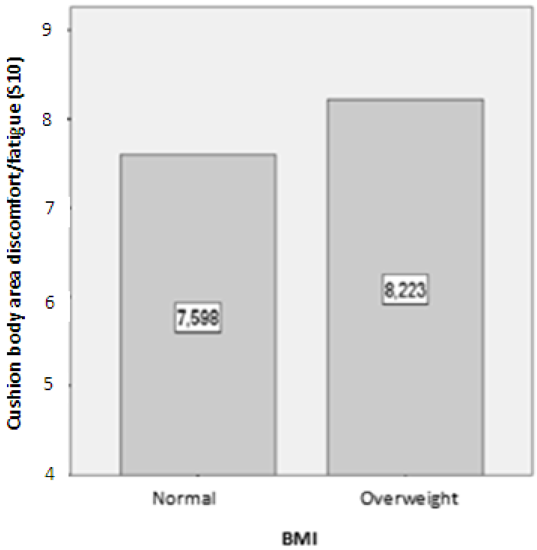


Figure 10. Mean of "Cushion body area discomfort/fatigue sensation (S10)" according to normal and overweight participants

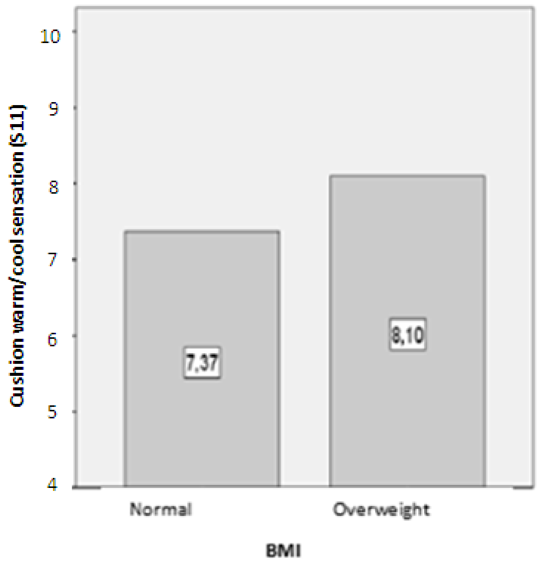


Figure 11. Mean of "Cushion warm/cool (S11)" according to normal and overweight participants

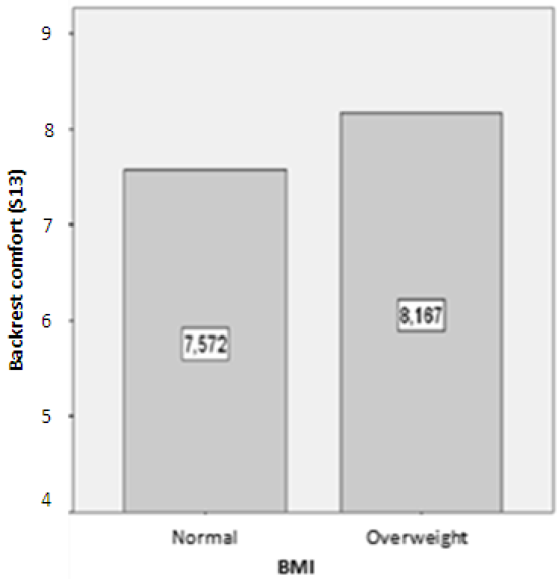


Figure 12.Mean of "Back rest comfort (S13)" according to normal and overweight participants

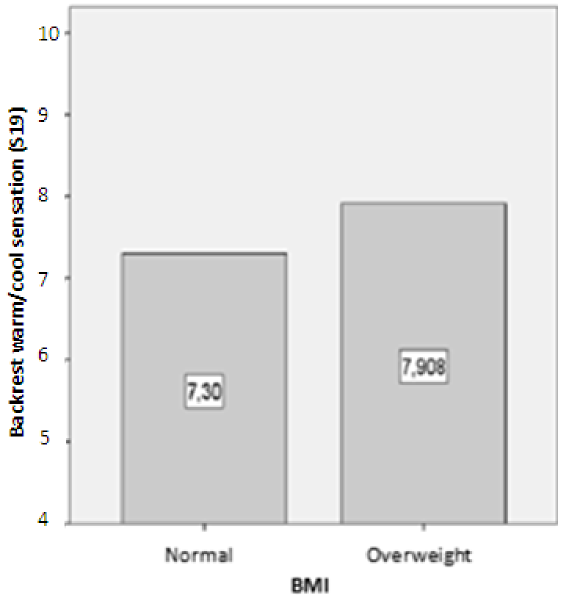


Figure 13. Mean of "Back rest warm/cool sensation (S19)" according to normal and overweight participants

3.6. Linear Regression Analysis

A linear regression analysis was used to evaluate the relations between all the parameters. An analysis of variance (ANOVA) was used for differences in the means of the dependent variable broken down by the levels of the independent variable. For the subjective assessment, the regression model was in good agreement for the selected parameters. In the regression model, the R value was 0.896 and R^2 was 0.803. The formula is as follows:

Seat comfort = (0.523*S4) + (0.593*S13) – (0.222*S18)

The dependent variable is seat comfort (S1) and the independent variables are cushion comfort (S4), back rest comfort (S13) and back rest body area discomfort/fatigue (S18).
For an objective measurement assessment, a linear regression analysis was also used for measured pressure areas. The regression model was in general agreement for the selected parameters. In the regression model, the R value was 0.902 and R^2 was 0.814. The formula is as follows:

P13 = 2.848 + (0.323*P16) + (0.514*P17)

The dependent variable is back rest pressure (P13) and independent variables are upper back pressure (P17), lumbar pressure (P16) and back rest lateral support pressure (P15).

4. Discussion

The purpose of this study was to evaluate car seat comfort by using a subjective evaluation system with road trials and by measuring seat pressure. Determining seat comfort in automobiles is a complex task because the comfort involves the interaction of many variables. Drivers react to many simultaneous variations and cannot be completely isolated from driving variables. Driver discomfort is a dynamic phenomenon (Porter et al., 2003), and drivers can experience discomfort from more than one source simultaneously (Norin and Wyon, 1992).
The majority of previous studies on comfort have been performed in a laboratory. The drivers in a laboratory cannot provide a realistic reaction because they drive using a simulation. However, in a road trial, they experience actual traffic conditions; they must pay attention to traffic lights, speed limits, pedestrians, etc. during the experiment and all of these conditions can affect body comfort (Cengiz and Babalik, 2007). Road trials are also very important for accurate assessments of survey results. There are few extended road studies in existing literature. The focus of this study is

to show how drivers are affected by seat comfort while experiencing actual road conditions.

A driver's evaluation of seat discomfort can change over time (Gyi and Porter, 1999). Cengiz and Babalik (2007) noted that road experiments should be carried out for periods longer than 1 hour. The Vehicle Ergonomics Group (VEG) determined that at least 2 h is required to clearly differentiate between various seats. In this study, the participants drove for at least 2.5 hours. The route included different types of roads such as urban, mountain, suburban and highways. Although the participants initially felt no discomfort, there was a significant change in comfort level after 75 minutes. This situation shows the effect of driving time on seat comfort during actual driving conditions.

It was shown that the parameters affecting seat comfort were generally related to thermal comfort. The survey results and the evaluated statistics both show that thermal comfort parameters received low marks, particularly as time progressed on the road. The principal factors affecting human thermal comfort depend upon four physical environmental variables: the air temperature, the relative humidity, the mean radiant temperature, and the relative air velocity. In addition, there are two independent but related parameters: the activity level provided by metabolism and the thermal insulation value provided by clothing (Alahmer, 2011). Because the road trials were carried out in warm weather and for nearly 2.5 hours, these complaints were expected. The initial complaints focused on the lumbar region; this conclusion is supported by Cengiz and Babalik (2007). Seat cover material can also affect thermal comfort; a fabric cover produces a considerably higher sweat transport than leather (Bartel, 2003). Recycled natural materials (such as a ramie-blended seat cover) have been found more comfortable than polyester seat covers (Cengiz and Babalik, 2009). In our study, a polyester seat cover was used; this material could be changed with a new seat design.

The overweight participants found the seat more comfortable than the subjects with a normal BMI. The excess of fat in overweight participants can be an important factor. The layer of fat can serve as a suspension between the driver and the seat. Because of this, overweight participants may have evaluated the car seat as more comfortable. Silva (2002) reported that comfort indices are related to human sensitivity and weighting. However, the influences of different variables were incorporated for each type of stimulus alongside discrete measured values of relevant physical parameters. On the other hand, when the previous literature was examined, there were no detailed studies on this topic.

5. Conclusion

In this study, a static and dynamic evaluation of car seat comfort was conducted. Participant comfort assessments were evaluated using a subjective questionnaire and static pressure measurements. An experimental study was performed to provide information on seat comfort while drivers were in actual traffic conditions for 2.5 hours. During the road trials, comfort assessments were performed at 4 times and 24 questions were asked about each section.

The level of comfort varied over time. The participants exhibited discomfort after 75 minutes. The sensation of thermal comfort directly affected seat comfort. The seat cover materials and thermal conditions in an automobile could be change with a new seat design. An acclimated car seat could generate a positive effect on comfort assessment.

The overweight participants found the seat more comfortable than the subjects with a normal BMI. New seat designs could be studied that would use different foam densities for drivers with normal BMI.

The results of this study will assist in the improvement of new car seat designs that are more comfortable and suitable.

Acknowledgments

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APPENDIX 1

STATIC/DYNAMIC SEAT COMFORT EVALUATION FORM

Date	**Outside temp. (^{0}C)**	**Participant's**				
		Name	**Age (years)**	**Height (cm)**	**Weight (kg)**	**Driving experience (years)**

Subjective questionnaire scale

1. Very unacceptable
2. Unacceptable
3. Poor
4. Mediocre
5. Acceptable lower limit
6. Acceptable
7. Fair
8. Good
9. Very good
10. Excellent

No	Question		Static	Dynamic		
			0min.	15min.	75min.	150min.
1	SEAT	comfort				
2		stiffness /softness				
3		lateral containment				
4	CUSHION	comfort				
5		stiffness /softness				
6		lateral containment				
7		thigh front support				
8		longitudinal containment	*			
9		performance in rough road	*			
10		body area discomfort/fatigue	*			
11		warm/cool sensation				
12		sensation of humidity				
13	BACKREST	comfort				
14		stiffness /softness				
15		lateral containment				
16		lumbar support				
17		performance in rough road	*			
18		body area discomfort/fatigue	*			
19		warm/cool sensation				
20		sensation of humidity				
21	HEADREST	comfort				
22		stiffness/softness				
23		space between head and headrest				
24	Evaluation of seat at the end of the test					

* : Not asked