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Educating Youth About Health and Science Using a Partnership Between an Academic Medical Center and Community-based Science Museum

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Abstract

Declining student interest and scholastic abilities in the sciences are concerns for the health professions. Additionally, the National Institutes of Health is committed to promoting more research on health behaviors among US youth, where one of the most striking contemporary issues is obesity. This paper reports findings on the impact of a partnership between Oregon Health and Science University (OHSU) and the Oregon Museum of Science and Industry linked to a 17-week exhibition of *BodyWorlds3* and designed to inform rural underserved youth about science and health research. Self-administered survey measures included health knowledge, attitudes, intended health behaviors, and interest in the health professions. Four hundred four surveys (88% of participants) were included in analyses. Ninety percent or more found both the Body-Worlds ($n = 404$) and OHSU ($n = 239$) exhibits interesting. Dental care habits showed the highest level of intended behavior change (Dental = 45%, Exercise = 34%, Eating = 30%). Overall, females and middle school students were more likely than male and high school students, respectively, to state an intention to change exercise, eating and dental care habits. Females and high school students were more likely to have considered a career in health or science prior to their exhibit visit and, following the exhibit, were more likely to report that this intention had been reinforced. About 6% of those who had not previously considered a career in health or science ($n = 225$) reported being more likely to do so after viewing the exhibits. In

conclusion, high quality experiential learning best created by community-academic partnerships appears to have the ability to stimulate interest and influence intentions to change health behaviors among middle and high school students.

Keywords

Health promotion; Health education; Community-institutional relations; Rural health; Adolescent; Program evaluation

Introduction

Declining interest and scholastic abilities in the sciences among grade school students are concerns for the health professions [1,2]. This is especially true for underserved youth, who can provide important diversity to the health professions and needed health care services to their home communities [3]. Some educational programs addressing this issue have focused on creating partnerships between middle and high school teachers and visiting scientists intended to foster student interest and provide opportunities for scientist and teacher professional development [4]. However, research on the impact of such programs is limited.

The National Institutes of Health, the federal agency responsible for the majority of health research funding in the United States, is committed to promoting more research on health behaviors among US youth, where one of the most striking contemporary issues is obesity [5–7]. Most programs that address health promotion of youth are school-based [8–12]. Much less is known about the potential impact of partnerships between academic and community organizations on sparking interest in the health professions and possibly affecting health behaviors of underserved youth. Studies have consistently shown that social inequality, as measured by a range of factors including socioeconomic status and parental education, is associated with lower health status and higher levels of risky behavior among youth, although results vary somewhat by age, sex, and outcome variable [13–18]. The association between health status and rural residency is a bit more complex; the direction of the relationship changes according to race/ethnicity and specific health outcome [19–21]. For example, rural residency appears to be a disadvantage for Latino, Asian, and Native American youth as measured by chronic illness likelihood, but not for Whites or African Americans [20].

In the summer and fall of 2007, Oregon Health and Science University (OHSU) partnered with the Oregon Museum of Science and Industry (OMSI) to bring Gunther von Hagen's *BodyWorlds3* exhibit of plastinated bodies to Portland Oregon [22]. The exhibit was on display at OMSI for 17 weeks. In conjunction with the *BodyWorlds3* exhibit, OHSU developed and staffed a series of thematic exhibits covering seventeen topic areas in health and medicine, from cancer to nutrition to addiction. The thematic exhibits were designed to showcase OHSU's role in research, education and health care provision. Lastly, a program developed specifically for underserved youth in Oregon, called Science in the City, provided rural students an opportunity to explore their interest in science and the health professions through a visit to both the *BodyWorlds* and OHSU research exhibits. The purpose of this paper is to describe the impact this program had on health knowledge, attitudes, intended health behavior changes, and interest in the health professions among disadvantaged rural Oregon Youth. We specifically explore how these factors may be influenced by student gender, school grade level and race/ethnicity.

Methods

Detailed methods of the development of the exhibits are published elsewhere [23]. A planning committee was formed between the academic and administrative communities at OHSU and OMSI. The planning committee developed strategies for creating 17 thematic research presentations, which were rotated weekly over the 17 weeks of the *BodyWorlds* exhibit. An evaluation subcommittee was formed to create instruments, develop assessment approaches, and collect and analyze data. All evaluation activities were reviewed and approved by the OHSU IRB. Evaluations were conducted for school groups through the Science in the City program (ages 10–18) and for general public visitors age 18 and over. Specific methods and findings from the adult portion of the project are reported elsewhere [23].

Science in the City was designed to provide underserved students in Oregon an opportunity to explore their interest in science and technology. OMSI invited rural district superintendents to allocate program slots to middle and high school science teachers from their district. Students from these rural middle and high schools arrived at OMSI in the early afternoon, toured both *BodyWorlds* and OHSU research exhibits and watched the Omnimax film *The Human Body* before departing for a local middle school where they attended a series of workshops on the health professions and stayed overnight. The OHSU thematic exhibits were physically located in the hallway just outside the *BodyWorlds* exhibit; students had to pass by them to reach the rest of the museum but the layout did not require them to stop and look.

Survey Design and Testing Procedures

Survey questions and response categories were phrased to fit the middle and high school demographic, and relevant topics were added or deleted to fit the experience of the Science in the City participants, while addressing evaluation objectives. The final instrument included twelve questions covering reaction to the *BodyWorlds* exhibit, the OHSU exhibits and the entire experience at OMSI, impact on interest in careers in health or science and on intent to change specific health-related behaviors associated with the exhibits, and basic demographics. The survey asked two open-ended questions: (1) What is the most important thing you learned about research at OHSU, and (2) What was the most interesting thing that you learned as a result of your experience today at OMSI. The survey instrument was pilot tested with ten *BodyWorlds* exhibit visitors between the ages of twelve and twenty prior to deployment.

Data Collection

Following their visit to OMSI students departed for the middle school where evaluation team members met with them prior to the scheduled evening workshops. A team member described the purpose of the survey, explained that it was anonymous and voluntary, clarified some points in the survey, and answered any questions. Surveys were handed out to all students present at the school; one school group left for home directly from OMSI and these students were unable to participate. The surveys generally took between 5 and 15 min to complete. Students were also given a separate sheet of paper with a brief description of the research and contact information in case they or their parents were interested in learning more.

Data Analysis

All numerically scored questions were coded by an evaluation team member and sent to an outside company for data entry. Frequency reports and cross-tabulations were then run using SPSS (Statistical Package for the Social Sciences v16). In addition, grade level was collapsed into a dichotomous variable (middle school = grade 6–8; high school = grade 9–12) and race/ethnicity was collapsed into six categories (African American only, Caucasian only, Native American only, Asian only, Hispanic only and Mixed Race). Outcome measure response categories were also collapsed to enable analyses and interpretation. Answers to the two

questions on perception of the exhibits were dichotomized into 'not interesting' (not at all interesting, not very interesting) and 'interesting' (somewhat interesting, very interesting). Answers to the questions on intention to change health behaviors were collapsed into three distinct categories: 'disagree' (strongly disagree, disagree), 'neutral', and 'agree' (agree, strongly agree). Descriptive statistics were used to examine response categories overall for study participants and according to sex, grade level in school, and race/ethnicity. Subgroup comparisons were performed for categorical data analysis using chi-square analysis with two-tailed alpha set to 0.05.

A codebook for the open-ended questions was developed using a standard iterative process and thematic analysis performed, facilitated by the QSR NVivo software. Two members of the evaluation team independently coded 50% percent of the surveys; the codebook was revised and surveys re-coded until an inter-coder agreement level of 80% was reached.

Results

Four hundred sixty students from small (<100 students) rural middle and high schools took part over 3 days in September 2007. A total of 404 students completed the survey (87.8%). The majority of respondents (56%) were female, and ages ranged from 10 to 18 with grades 6 through 12 represented (Table 1). Seventeen percent of respondents identified themselves as Hispanic. Students could self-identify as one or more races with 66% identifying themselves as White and 12% as Native American. A higher proportion of females were represented in the high school participants (63%) than among middle school participants (55%).

When asked how they would describe their visit to the *BodyWorlds3* exhibit, over half (52.9%) found it very interesting, 41.4% found it somewhat interesting, and 5.4% said that it was not very or not at all interesting. Nearly 60% of the students ($n = 239$) reported that they stopped at the OHSU exhibits. Of these 239 students, 29.3% found them very interesting, 61.6% found them somewhat interesting, and 9.7% found them not very or not at all interesting. Figure 1 illustrates the proportion of respondents who found the exhibits interesting according to gender and grade level in school. As indicated, interest in both exhibits met or exceeded 90%. Table 2 outlines interest in the exhibits according to ethnicity. Interest in *BodyWorlds* was lowest by Asian students and highest by Caucasians. Interest in the OHSU exhibits was also lowest by Asians but highest by African American and Native American students. Statistical differences among race were noted only for the *BodyWorlds* exhibit. This may be due to the fact that *BodyWorlds* was visited by more students than the OHSU exhibits.

All student participants were asked how their experience at *BodyWorlds* and OMSI influenced their intentions to change certain health behaviors. Their responses indicate that, as a result of their Science in the City experience: 34% intend to change the amount of exercise they do, 30% intend to change their eating habits, and 45% intend to change how they care for their teeth. Our assessment of students' intentions to change health behaviors indicates that females were more likely to describe intentions to change exercise routines and eating habits compared to males (Table 3). Middle school students were also more likely to intend to change all health related behaviors compared to high school students. Results stratified by race/ethnicity indicate that Native Americans had the highest level of intention to change exercise behavior, while African Americans were least likely to indicate an intention to change this behavior. Intention to change eating habits was highest in Hispanic and Asian students and lowest among African Americans. Intention to change dental care habits was high across all race/ethnicity categories; all race/ethnicities except Native American and Asian were more likely to say they intended to change dental than eating or exercise habits (Table 3).

Of the students who answered the question on career choice ($n = 385$), 41.5% reported considering a career in health or science before the visit to OMSI with Science in the City. Of these students ($n = 160$), 53.8% answered 'agree' or 'strongly agree' when asked whether, as a result of their visit to OMSI today, they are now more likely to have a career in health or science. This indicates that 46.2% of those initially interested reported not being more so after the exhibit. Of the 225 students who were not previously considering a career in health or science, 5.8% reported that they are now more likely to consider such a career. Females and high school students were significantly more likely both to have previously considered a career in health or science and to now be more likely to have such a career as a result of the visit to the OMSI exhibits (Table 4, Table 5). There were no significant differences in career choice by race/ethnicity.

The first open-ended question asked those students who had visited the OHSU exhibits ($n = 239$) to identify the most important thing they learned about research at OHSU. Forty-nine students who had stopped at the OHSU exhibits left the question blank and an additional 39 students wrote "don't know," leaving 151 responses for coding. Thematic response categories for those 151 individuals, ordered by frequency of occurrence and with sample quotes, are shown in Table 6. Observations on specific clinical subjects, general statements on anatomy and the body, and health promotion were the most frequently mentioned topics. All students were also asked to identify the most interesting thing they learned as a result of their experience at OMSI. Seventy-six participants declined to answer and 21 responded "don't know," leaving 307 written answers (Table 7). Statements about anatomy were followed in frequency by mentions of a specific exhibit (e.g., Omnimax, plastination), finding the entire experience interesting, and health promotion.

Discussion

Our study successfully captured nearly 88% of rural underserved youth who visited a metropolitan museum to visit exhibits related to health and health sciences. We learned that the vast majority (90% or more) found both the *BodyWorlds3* and OHSU exhibits interesting, which may be associated with selection bias as those most interested in health and science topics may have been those more likely to decide to take such a trip. The demographics of our participants indicate we succeeded in reaching more Native American and Hispanic youth than exists in the general population in Oregon [24]. This may be due to the focus on small rural school districts. Our population was relatively evenly split between middle school and high school students.

We were very interested in assessing how the exhibits may affect students' intention to change health behaviors and were not surprised to learn that females were more interested in changing exercise and eating habits. This may be because they pay more attention to body image, which can be a concern as well as a positive factor. If these girls and young women are already thin, concerns would be raised about anorexia or bulimia [25,26]. However, given the rapid rise in childhood obesity, being overweight could be a concern as well [27,28]. It may be that boys are already exercising or eating more appropriately and did not see these areas as ones where a change in behavior would be considered. Unfortunately, we did not collect information on body mass index, which would have helped interpret this finding in detail.

Interestingly, there were higher levels of interest in behavior change among middle school versus high school students. This raises the question about whether middle-aged school children are more open to or interested in health and healthy behavior than high school students are. This seems to be an unexplored research question; a literature search found no studies addressing the relationship between youth age and openness to health behavior change.

We were initially surprised to learn that the greatest area of behavior change was in dental care habits, which was true across gender, grade and most race/ethnicity categories. The OHSU School of Dentistry exhibit was the first students encountered when exiting BodyWorlds 3 and, unlike most of the other OHSU exhibits that rotated through weekly, was designed to be unstaffed and was on display for the entire 17 weeks. The display featured graphic depictions of dental anomalies and historical dentistry tools, a demonstration featuring teeth in development at various ages, interactive games with oral health themes and hands-on ability to examine types of dental restorations, all of which were attractive to students and may have contributed to this result. One additional factor in this heightened interest may be that rural Oregon has a shortage of dentists and dental hygienists [29].

Responses to the open-ended questions provide additional evidence of the potential impact of this educational format on the health behavior of youth. Statements referencing a learned health promotion behavior, from the general (“How to take care of myself”) to the more specific (“I learned that smoking is disgusting and unhealthy”; “I’m supposed to drink way more milk than I do”; “To be healthy and exercise more”) were a common answer to questions on important and interesting things learned from the OMSI experience.

Another notable point concerns understanding of the basic concept of research. Responses to the question “What is the most important thing you learned about research at OHSU?” were seldom phrased in research terms or referred directly to research results. It would be interesting to explore how middle and high school students distinguish “research” from “science” or “anatomy,” as well as the implications this may have for both education and measurement.

We found that interest in health and science careers was modest. Few students shifted from not interested before to more interested after, while almost 20% (74 students) who were interested before viewing the exhibits were not more likely to be interested in a health/science career as a result of Science in the City. This finding has been a challenge to interpret. On the one hand, those interested before may still be interested and this is unchanged as a result of the exhibit. On the other hand, the exhibits may have negatively affected their career interests. The *BodyWorlds* exhibit is quite graphic in its display of the human body, and we wonder if this may have affected students’ interest. Unfortunately, the way we worded this question will not allow us to determine which direction to interpret these findings.

Strengths of our study include its high response rate and the fact that missing data occurred in <5% for any response category, indicating it is possible to capture data on underserved youth using the format that we did. Limitations of the study included that it was a single post exhibit survey, which limits the interpretation of findings. Due to the rotating schedule of OHSU research exhibits, staffing and exhibit topics were not the same for each of the three Science in the City groups. Also, since selection criteria for program participation varied by district and teacher, we are unable to determine the extent to which the student participants had previously expressed interest or aptitude in health and science. Another limitation is that we assessed a specific program designed to target rural disadvantaged youth, rather than surveying youth between 10–18 years of age that visited the exhibits outside of our program. Having this comparison would have allowed for a more comprehensive assessment of this kind of exhibit and how it affects both children and young adults in and outside a program like Science in the City. Lastly, some of the cell sizes were quite small for the race/ethnicity stratification. We explored the frequencies for several possible groupings before conducting final analyses for race/ethnicity data. Understanding how ethnicity influences health beliefs, intention to change health behaviors and interests in health careers is very important, and we hope that others will attempt to replicate this work with more robust sample sizes to further add to the literature. This evaluation was the first conducted through the OHSU–OMSI partnership, and all involved

learned valuable lessons on working together to conduct rigorous, high quality research that will benefit future collaborations.

In conclusion, high quality experiential learning best created by community-academic partnerships appears to have the ability to stimulate interest and influence intentions to change health behaviors intentions among middle and high school students.

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Fig. 1.
Perception of exhibits as interesting according to gender and grade

Table 1
Demographic characteristics of study participants ($n = 404$)

Characteristic	<i>n</i>	%
Gender/Sex		
Males	162	40.1
Females	225	55.7
Missing/Unknown	17	4.2
Age		
10	2	0.5
11	70	17.3
12	77	19.1
13	49	12.1
14	18	4.5
15	29	7.2
16	55	13.6
17	67	16.6
18	18	4.5
Missing/Unknown	19	4.7
Grade		
Middle school (grades 6–8)	207	51.2
High school (grades 9–12)	179	44.3
Missing/Unknown	18	4.5
Hispanic		
Yes	70	17.3
No	319	79.0
Missing/Unknown	15	3.7
Race		
African American only	13	3.2
Caucasian only	223	55.2
Native American only	22	5.4
Asian only	14	3.5
Mixed race	48	11.9
Other (Hispanic only)	52	12.9
Missing/Unknown	32	7.9

Table 2
Perception of *Body World* and OHSU research exhibit as interesting by race/ethnicity

Perceptions	African American only (n = 13)	Caucasian only* (n = 220)	Native American only (n = 22)	Asian only* (n = 11)	Hispanic only (n = 52)	Mixed race (n = 48)	P value
Body world exhibit							
Number of total respondents	13	220	21	11	48	42	
% Responding yes	92.3%	97.3%	95.5%	78.6%	92.3%	87.5%	0.01
OHSU exhibit							
Number of total respondents	4	137	7	11	34	27	
% Responding yes	100.0%	91.2%	100%	81.8%	88.2%	92.6%	0.76

* Three responses missing from these categories

Table 3
Levels of intention to change health behaviors as a result of visiting the exhibits by demographics

Gender			Grade		Race/Ethnicity							
Male (n = 162) (%)	Female* (n = 223) (%)	P value	Middle school* (n = 204) (%)	High school (n = 179) (%)	P value	African American only (n = 13) (%)	Caucasian only* (n = 221) (%)	Native American only (n = 22) (%)	Asian only* (n = 13) (%)	Hispanic only (n = 52) (%)	Mixed race (n = 48) (%)	P value
Intention to change exercise routine												
Disagree	25.9	10.8	17.6	19.0	0.003	46.2	18.1	18.2	0	21.2	12.5	0.002
Neutral	44.4	51.8	41.2	55.9		38.5	52.5	22.7	46.4	30.8	54.2	
Agree	29.6	37.4	41.2	25.1		15.4	29.4	59.1	53.8	48.1	33.3	
Intention to change eating habits												
Disagree	31.7	19.3	19.5	31.3	0.005	53.8	24.4	27.3	7.7	13.5	22.9	0.001
Neutral	44.1	46.6	43.9	45.3		46.2	47.9	40.9	38.5	30.8	54.2	
Agree	24.2	34.1	36.6	23.5		0	27.6	31.8	53.8	55.8	22.9	
Intention to change dental care habits												
Disagree	22.8	11.7	12.2	22.3	<0.001	23.1	18.9	18.2	0	15.4	14.6	0.122
Neutral	32.1	42.2	28.8	48.6		38.5	41.4	27.3	53.8	21.2	39.6	
Agree	45.1	46.2	59.0	29.1		38.5	39.6	54.5	46.2	63.5	45.8	

* One to three responses missing in these categories

Table 4

Influence of exhibits on choice by demographics

	Gender		Grade		Race/Ethnicity							P value		
	Male (n = 162) (%)	Female* (n = 223) (%)	P value	Middle school* (n = 204) (%)	High school (n = 179) (%)	P value	African American only (n = 13) (%)	Caucasian* only (n = 221) (%)	Native American only (n = 22) (%)	American Asian* only (n = 13) (%)	Hispanic only (n = 52) (%)		Mixed race (n = 48) (%)	
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Considered a career in health or science before exhibits														
No	67.7	51.4	0.002	69.3	45.7	<0.001	41.7	59.4	70.0	35.7	58.3	59.6	0.349	
Yes	32.3	48.6		30.7	54.3		58.3	40.6	30.0	64.3	41.7	40.4		
More likely to have a career in health or science because of the exhibits														
Disagree	46.3	37.1	0.004	47.6	34.1	0.026	38.5	39.6	50	21.4	42.3	56.3	0.56	
Neutral	36.4	30.8		29.6	35.8		38.5	34.7	27.3	35.7	30.8	22.9		
Agree	17.3	32.1		22.8	30.2		23.1	25.7	22.7	42.9	26.9	20.8		

* One to three responses missing from total in these categories

Table 5
Attitudes toward health careers before and after the exhibits ($n = 385$)

	More likely to have a career in health or science because of the exhibits		<i>P</i> value
	No ($n = 286$)	Yes ($n = 99$)	
Considering career in health or science before the exhibits			
No ($n = 225$)	$n = 212$ 55.1%	$n = 13$ 3.4%	<0.001
Yes ($n = 160$)	$n = 74$ 19.2%	$n = 86$ 22.3%	

Table 6

Responses to most important thing learned about research at OHSU?

Response category	Definition	# Mentions	Sample quotes
Specific clinical topics	Any mention of clinical or body-related topics, with or without specific facts associated with the comment	45 (3 fetal/baby; 5 bone density; 5 dental; 21 hearing; 11 life expectancy)	"The safe level to listen to the sound"; "I learn that emale live 5 to 10 year more than male"; "The teeth"
Body knowledge	General observations on the body, statements that learned how bodies work or what they look like	40	"How complex the body truly [sic] is"; "I learned what organs when were [sic] and how they worked"; "That you have about 2,000 blood cells that die every day"
Health promotion	Statements that something had an impact on future health behaviors (impact can be inferred)	32	"It is important to take care of your body"; "Brush your teeth good"; "Protect hearing"
Exhibit type	Any mention of a specific type of exhibit or exhibit component, including Omnimax, the interactive exhibits and plastination	10	"The movie"; "Games"; "There is a process that turns people into plastic and preserves them better"
Interesting	Statements that the exhibits, science or something about the experience was interesting/cool/fun	10	"How much fun one can have while you learn"; "I learned how interesting things can be"
Learned nothing	Specific statement that the person did not learn anything	10	"I didn't learn anything"
Statements on science/Research	Comments on scientific, research or education methods or aims	9	"That is can be made interesting to kids"; "What we can learn from observation"; "Curiosity leads to great discovery"

Table 7

Responses to most interesting thing that learned as a result of experience at OMSI?

Response category	Definition	# Mentions	Sample quotes
Our bodies	Statements about the body, what it looks like, how it works, anatomy. Includes cells, prenatal, pregnancy, babies	171	"My body"; "I learned how your body looks inside"; "That you can get fat around your heart"; "What babies look like at different stages"; "You get 2 million blood cells every day"
Exhibit type	Any mention of a specific type of exhibit. Includes Interactive exhibits, Omnimax, Plastination (animals or plastinated bodies), BodyWorlds	62	"The dead people"; "The movie"; "Energy makes your hair staticy"
Fun & fascinating	General positive statements about the OMSI/ BodyWorlds experience; finding it interesting. Includes if said find "everything" interesting	28	"Science is fun"; "Everything was interesting"; "Everything was cool"
Health promotion	Comments that something had an impact on future health behaviors Includes smoking	24	"Don't do smoking"; "Brush your teeth"
Nothing learned	Specific statement that the person did not learn anything	13	
Philosophical	Statements on the meaning of the body, life, mortality, exhibit, etc.	7	"God"; "The realities of mortality"